Mining Journal

VOLUME 99 MARCH 27, 1915 NUMBER 13

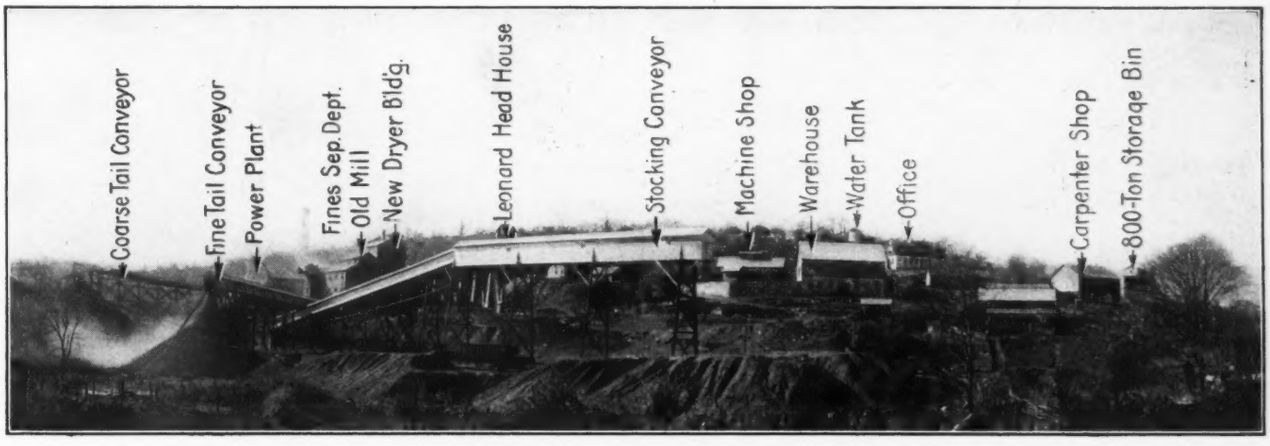
Magnetic-Concentration Mill at Mt. Hope, N. J.

By Samuel Shapira*

SYNOPSIS—This mill, owned and operated by the Empire Steel & Iron Co. of Catasauqua, Penn., and equipped to concentrate northern New Jersey iron ores, has lately been redesigned and improved so that it now is thoroughly uptodate and efficient. Ball and Norton magnetic-separating machines of the belt, drum and pulley types are used, and finished concentrates, middlings for retreatment and tailings are made. An improved type of tower dryer is a feature. The mill has a capacity of 60 tons per hour.

The Empire Steel & Iron Co.'s mines and plant are at Mt. Hope, three miles north of Wharton, N. J. The Mt. Hope Mineral R.R. runs from the mines to Wharton and there connects with the main line of the Lackawanna R.R. and the Central R.R. of New Jersey. The road is standard gage and has a grade for its entire length in favor of the load.

During the last 2½ years the company has successfully carried out a policy of development and improvement which has placed it in a position to mine and mill 1000 tons of ore a day. The old mill, built in 1908, was originally designed to treat the high-grade ores from the Elizabeth vein. It was changed to meet the requirements of greater capacity and of the lower grade ores coming from the Taylor, Finley and Leonard veins. Additional improvements include a separate building for the treatment of fines, a new dryer building and a system for stocking and reclaiming 30,000 tons of concentrates.



A Panoramic View of the Mt. Hope Plant

Preliminary Crushing and Storage

Formerly all ores were hoisted through the Leonard shaft and delivered by means of a Hunt automatic railway, about 75 ft. long, to the crude-ore bin at the head of the mill. The three-compartment Brown shaft, about 1000 ft. north of the mill, is now the main hoisting shaft and it is here that the preliminary crushing is done.

The ore hoisted through the Brown shaft is dumped into a 100-ton steel ore bin which discharges on a 48-in. pan conveyor. The discharge from the bin is regulated by a rack-and-pinion hand-operated ore-bin gate. The pan conveyor rises at an angle of 14°, is 20 ft. 9 in. between centers and can be driven at a speed of 3, 5 or 7 ft. per minute. The ore carried by the pan conveyor is received by a 36x24-in. Farrel-Bacon jaw crusher, which has a capacity of 85 tons per hour, crushing to 5 in. From the crusher the ore passes to the No. 14 conveyor belt, which is 24 in. wide, with four-ply center and six-ply edges. This is a Robins conveyor, 204 ft. 8 in. between centers, having a slope of 20° for 121 ft. 8 in. and traveling level for 83 ft. This level part is 40 ft. 8 in. above the loading track, is provided with a hand-propelled tripper and is directly over an 800-ton storage bin. The conveyor has a speed of 200 ft. per minute.

The storage bin, built entirely of wood, is lined on all sides and bottom with a double thickness of 3x8-in. spruce planks. The wear is taken by 20-lb. rails spaced at 4-in. centers and laid on the 3x8-in. planks, the spaces between

*Mining engineer, Mines Management Co., 60 Broadway, New York City.

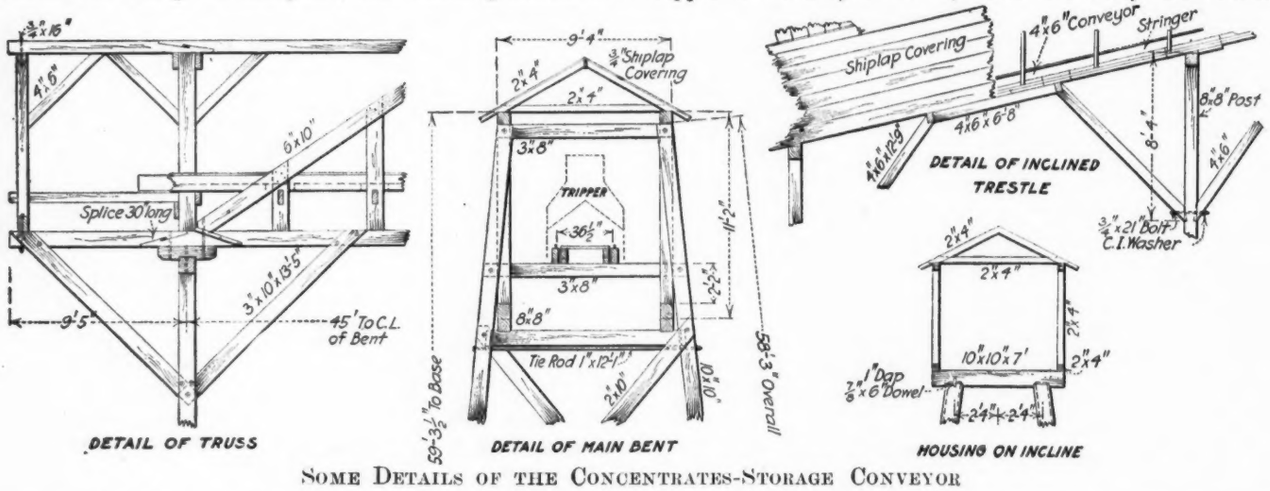
the rails being filled with hardwood wearing strips. The bin has a 45° bottom; the inside dimensions are 70 ft. 1 in. by 14 ft. by 20 ft. 4 in. A partition divides the bin into two sections, each provided with three 24x30-in. hand-operated rack-and-pinion gates.

The crusher, pan conveyor and transmission machinery are housed in a frame building covered with corrugated iron. The 100-hp. Westinghouse motor driving the installation is housed in a separate and adjoining room. The trestle containing the 24-in. conveyor is housed, as is also the top of the storage bin. These housings are covered with corrugated iron.

Secondary Crushing and Storage

From the 800-ton storage bin the ore is loaded by means of steel chutes into 110,000-lb. capacity steel hopper-bottom gondolas and hauled by a small locomotive to the trestle and ore bin at the head of the mill.

The bin is rectangular, 43 ft. 3 in. by 18 ft. by 24 ft. 6½ in. deep with 24-in. stone and concrete walls, and has a flat bottom. The bottom and ends are kept permanently filled with broken ore and owing to the discharge gate being to one side of the center line of the bin only a 100-ton working capacity is obtained. To make up for this loss of storage at this point, four loaded gondolas are constantly kept on the trestle and are dumped into the bin as required.



Some Details of the Concentrates-Storage Conveyor

The ore is drawn from the bin through an air-operated gate by a shaking grizzly. This grizzly is 6 ft. long by 3 ft. 4 in. wide with 12-in. sides. It is hung from overhead by two adjustable suspension arms on the back end and is supported in front by two eccentric bearings on a 3-in. steel driving shaft. Power to drive the grizzly is obtained by belt and pulleys from the countershaft of crusher No. 1. When first installed the grizzly was made up of 14 manganese-steel bars with 2-in. spaces. Owing to serious clogging these bars were later replaced by a ¾-in. thick manganese-steel plate, 57x39-in., with 2-in. round holes, and no further trouble was experienced. The shaking grizzly discharges into crusher No. 1, the throughs bypassing and entering the boot of bucket elevator No. 1 by means of a gravity chute and a feed hopper.

In the operation of the ore-bin gate, which runs in angle-iron guides, a 12-in. diameter by 4-ft. stroke Curtis double-acting air cylinder is used. This cylinder is hung on the concrete wall of the bin and above the gate.

Crusher No. 1 is a No. 7½K Gates gyratory of Allis-Chalmers make and runs at a speed of 345 r.p.m. and crushes to a maximum of 4 in. From this gyratory crusher the ore falls through a gravity chute to a feed hopper, which in turn delivers it to the 16-in. bucket elevator No. 1. This elevator is a No. 5, style "B," Gates type, of Allis-Chalmers make, has an inclination of 69½° and is 58 ft. long between head and foot pulleys. The buckets are made of steel plate and are 16 in. wide, 11 in. on the belt, and have an 8-in. lip. They are bolted at 14-in. centers to an 18-in., 10-ply belt having a speed of 188 ft. per min. This gives the elevator a maximum capacity of 205 tons per hour or 1640 tons per shift of eight hours. Due to intermittent feeding the elevator is never called upon to convey this amount of ore.

From this elevator the ore is discharged into the No. 5 trommel screen where the first sizing is done. This screen makes two sizes: on 2 in. and through 2 in. The screen, which is of the Gates patent "iron-frame" type, is made up of one section 6 ft. long by 32 in. diameter, $\frac{5}{16}$-in. steel with 2-in. round holes, and has an inclination of 1¼ in. per ft. The oversize passes through a gravity chute to the No. 2 crusher, which is a No. 4K Gates gyratory, crushing to 2 in. maximum and discharging to the boot of elevator No. 1. The throughs from this screen pass to a feed hopper over conveyor No. 11, which is directly underneath the screen and delivers the ore to the new tower dryer No. 2. Conveyor No. 11 is 26 ft. between centers, has a slope of 18° and is 18 in. wide.

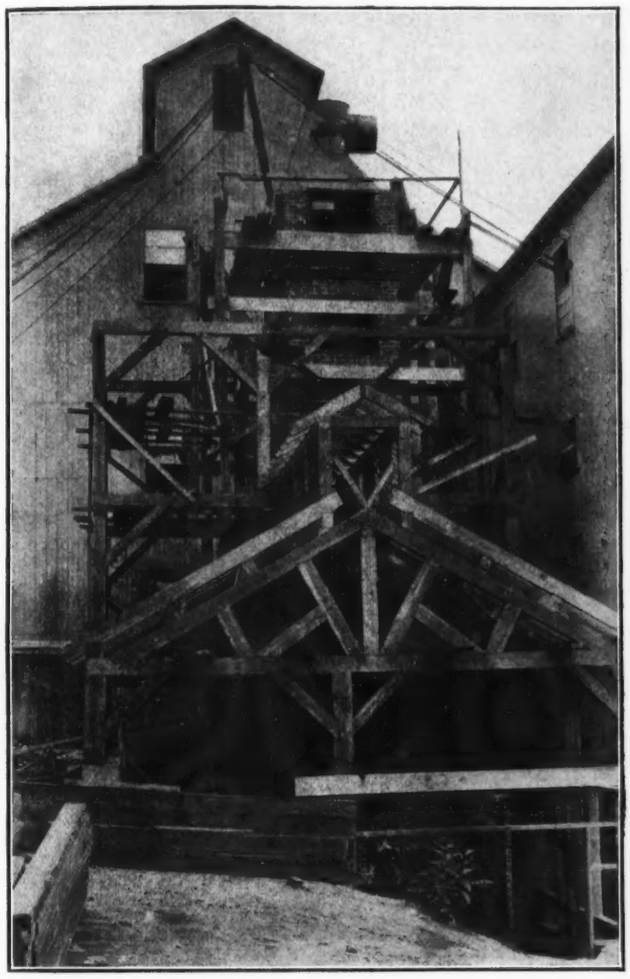
Rowand Type Tower Dryer

Invariably the Mt. Hope ore is wet, being especially so in the spring of the year. The dry magnetic-separation process is used in the Mt. Hope mill, and it is essential that the ore be dry before being sent to the magnetic-separating machines.

The drying is done in a tower dryer of new design, and all ore through 2 in. from screen No. 5 is conveyed to the top of the dryer. After drying, the ore is returned to the mill for further sizing, crushing and separation.

The tower dryer, with its furnace and accessory conveying machinery, is housed in a separate building of mill-type design. The dryer itself is simply a vertical square stack laid up of three courses of red brick and lined for a height of 11 ft. 10 in. with one course of firebrick. The stack is 5 ft. square inside by 45 ft. 4¼ in. high and rests upon a block of concrete 10x10x10 ft. A framework of structural iron encases the stack for its entire

height. The stack serves as the flue for the fire as well as the drying space for the descending ore. Baffle bars are placed in the stack in order that the ore may drop slowly through it and receive a thorough drying. The method of supporting these baffle bars differs from any heretofore used in tower dryers of this type. The dryer is made up of 10 sections or groups of tiers of baffle bars. Each section consists of four corner columns 6 in. square by 40 in. high, having sets of lugs on two adjoining sides. The columns are hollow and are independent of the brickwork of the stack and have a square recess at the lower end and a square shoulder at the upper end. The



NEW DRYER AND BUILDING DURING CONSTRUCTION

columns rest one on top of another, the shoulder of one fitting into the recess of the other, allowing the columns to be built up the same as a sectional bookcase. The four bottom columns rest upon base plates set into the brickwork of the stack. The columns, at two places in the stack, have projecting arms setting in the brickwork and are designed so that they do not rest upon the columns immediately below. This allows at these sections a 2-in. space for expansion. The lugs on the adjoining sides of these corner columns are spaced to take end bearing bars which at the same time act as spreaders. The bearing bars are slotted to take the baffle bars. The first seven sections of the dryer, beginning at the bottom, are laid up as follows: Each section consists of five tiers of baffle bars, with five bars per tier, the clear space being 6 in. between the bars horizontally and 8 in. vertically. The tiers of bars in each succeeding section are at right angles to those in the preceding section. In section No. 8, the third from the top, there are four tiers with four bars per tier, the clear space being 7 in. between the bars horizontally and 10 in. vertically. In section No. 9 the arrangement is three tiers high with three and four bars per tier and with 10- and 10½-in. spaces horizontally and 12-in. spaces vertically. In section No. 10, the top, the arrangement is two tiers high with three and four bars per tier, and with 10- and 10½-in. spaces horizontally and 15-in. spaces vertically. The graded spacing of the bars in the upper sections allows a greater freedom for the falling ore than would otherwise be the case, the idea being not to retard the velocity of the ore too quickly in the upper and colder sections of the dryer. The baffle bars for the three upper sections are 4 ft. 8 in. long by 9 in. wide by 1 in. thick. The bars for the lower sections are 4 ft. 8 in. long by 6 in. wide by ¾ in. thick. The bearing or spreader bars for all sections are 4 ft. long by 6 in. wide by ¾ in. thick. All bars have a T cross-section. Each section of the dryer is provided with doors for access to the bars in case of renewal or a block in the dryer.

The furnace attached to the dryer stack has a firebox 6 ft. 9 in. by 7 ft. 6 in. which is filled with "Tread-kill" dumping grates for burning No. 2 buckwheat coal under forced draft. The forced draft is obtained from a motor-driven Buffalo Forge Co.'s 45-in. steel-plate fan. This fan also provides air, which is made to pass first over and then under the arch of the firebox. This preheated air along with the hot gases from the furnace acts as the drying agent for the descending ore in the dryer. A motor-driven American Blower Co. No. 80 steel-plate exhaust fan placed at the top of the dryer helps to draw up the gases through the falling stream of ore. To the top of the dryer is fixed a steel-plate hood having a 20x12-in. opening for the ore and two outlets for the gases. One outlet is connected with the exhaust fan and the other with a 30-in. diameter by 20-ft. steel-plate stack. Each outlet has a damper so that the gases may be sent through the fan or up the stack, as desired.

The bottom of the dryer is provided with an outlet chute with a controlling rack-and-pinion gate through which the ore is delivered by means of a gravity chute and a feed-box to bucket elevator No. 4. This is a vertical double-chain elevator, 77 ft. 9 in. between centers, having two chains, each 162 ft. long, made up of steel inside and outside links, ⅜x2½x12 in. by 9 in. pitch. To these chains are attached 108 No. 10 steel-plate elevator buckets on 18-in. centers. The buckets have the following dimensions: 17¾ in. long by 10 in. wide by 10 in. projection. The head and boot shafts of this elevator are each provided with two manganese-steel sprocket wheels. The elevator has a speed of 131 ft. per minute and a capacity of 75 tons per hour.

From the elevator the ore is delivered by means of a gravity chute to the No. 12 belt conveyor. This belt is 18 in. wide by 26 ft. between centers, has a slope of 4°, and delivers the dried ore to trommel screen No. 1 in the old mill.

COARSE SCREENING, CRUSHING AND SEPARATING

Trommel screen No. 1, which is at the top of the old mill building, is 32 in. diameter by 8 ft. long. It has a dust

jacket of ¼-in. steel plate 48 in. diameter by 54 in. long with ½-in. round holes, and inside section of $\frac{5}{16}$-in. steel plate, 32 in. diameter by 4 ft. long with 1-in. round holes, and an end section 32 in. diameter by 4 ft. long with 1½-in. round holes. Three sizes are made—namely, through ½-in., which goes, by means of 16-in. belt conveyor No. 1, to screen No. 2 or to the old tower dryer, if desired; through 1-in. and 1½-in., which goes by means of a gravity chute to drum separator No. 1; and the oversize, on 1½ in., which goes by way of a gravity chute to drum separator No. 2.

Old dryer No. 1, which is housed in an annex to the old mill building, is a vertical brick stack with a 3-ft. square inside space filled with baffle bars. This dryer will now be used only in case of a breakdown of the new dryer.

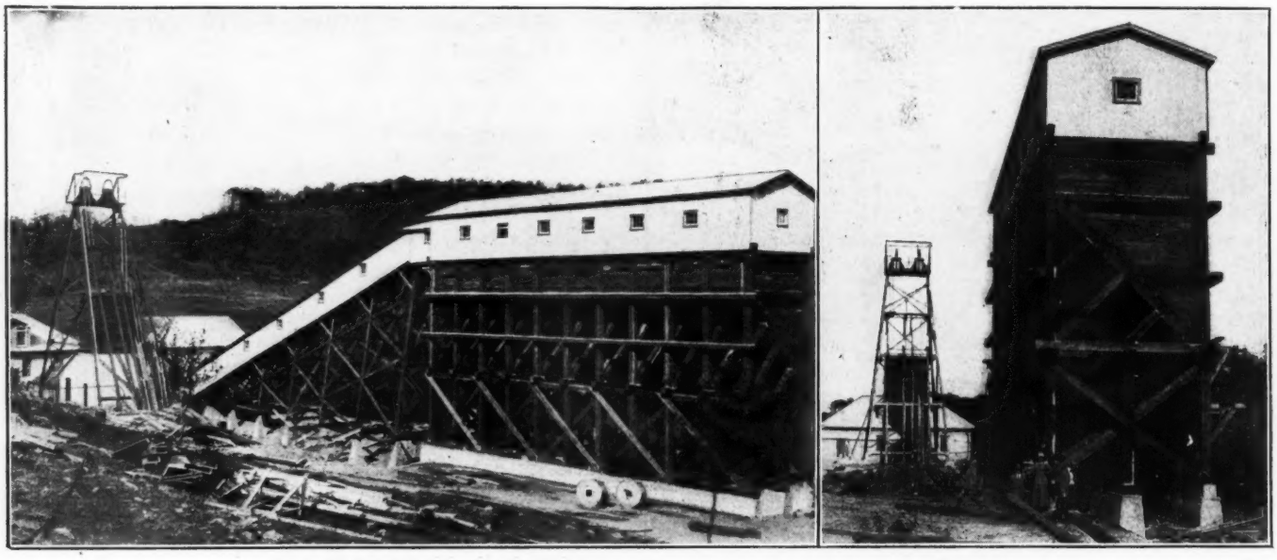
All magnetic separators are Ball and Norton machines. With the exception of drum separators Nos. 1 and 2, all the machines are on one floor level, the belt-type machines being in the fines-separating department. Each size of ore is treated on machines best adapted to handle it. Reference to the accompanying flow sheet will give a good idea of the arrangement of the machines and tne flow of material.

Drum separator No. 1, which is 30 in. diameter by 24 in. face, has a stationary yoke to which is attached a double row of magnets, each row consisting of 15 magnets. This machine carries 4.5 amp. at 250 volts and will handle from 20 to 30 tons per hr. Formerly all drum machines were provided with brass drums, but these have been replaced by manganese-steel drums, ⅛ in. thick, which have a life approximately four times that of the brass drums and cost one-fourth as much. Drum separator No. 1 makes a finished concentrate, which is sent by means of gravity chutes to concentrate belt conveyor No. 4, thence to the shipping bin. A middlings product is also made which goes by way of a gravity chute to pulley separator No. 1.

Drum separator No. 2, which is 36 in. diameter by 28 in. face, is equipped with a single row of 14 magnets connected in series. This machine carries 6 amp. at 250 volts and will handle from 20 to 30 tons per hr. The finished concentrates from this machine join the stream from drum No. 1, while the middlings pass through a gravity chute to pulley separator No. 2.

The pulley machines are short conveyors with 4-ft. centers, the head pulley of which is an electromagnet of the pulley-machine type. In this type of machine there is also a drum with an inside yoke to which are attached 24 magnets, but these, instead of being stationary, revolve with the shaft. These machines carry 12.5 amp. at 250 volts. They make tailings which will average 11% in iron. The middlings from these machines pass by way of gravity chutes to 40x15-in. Anaconda rolls for further crushing. The principal advantage of the pulley machine is that it will make clean rock, which is discarded before fine crushing commences, and only the sized middlings product is fed to the rolls. Thus excess separator and roll capacity is obtained.

The tailings from pulley separators Nos. 1, 2, 3 and 4 pass through gravity chutes to No. 2 conveyor. This is an 18-in. belt conveyor, 114-ft. centers, having a 12° slope and a speed of 309 ft. per min. The discharge end of this conveyor is fitted with a two-way chute so that the tailings may be sent to the rock screen No. 3 over the rock bin or, if desired, to 18-in. belt conveyor No. 6 which discharges on to the coarse-tailings dump.



THE 800-TON ORE BIN, SIDE AND END VIEWS

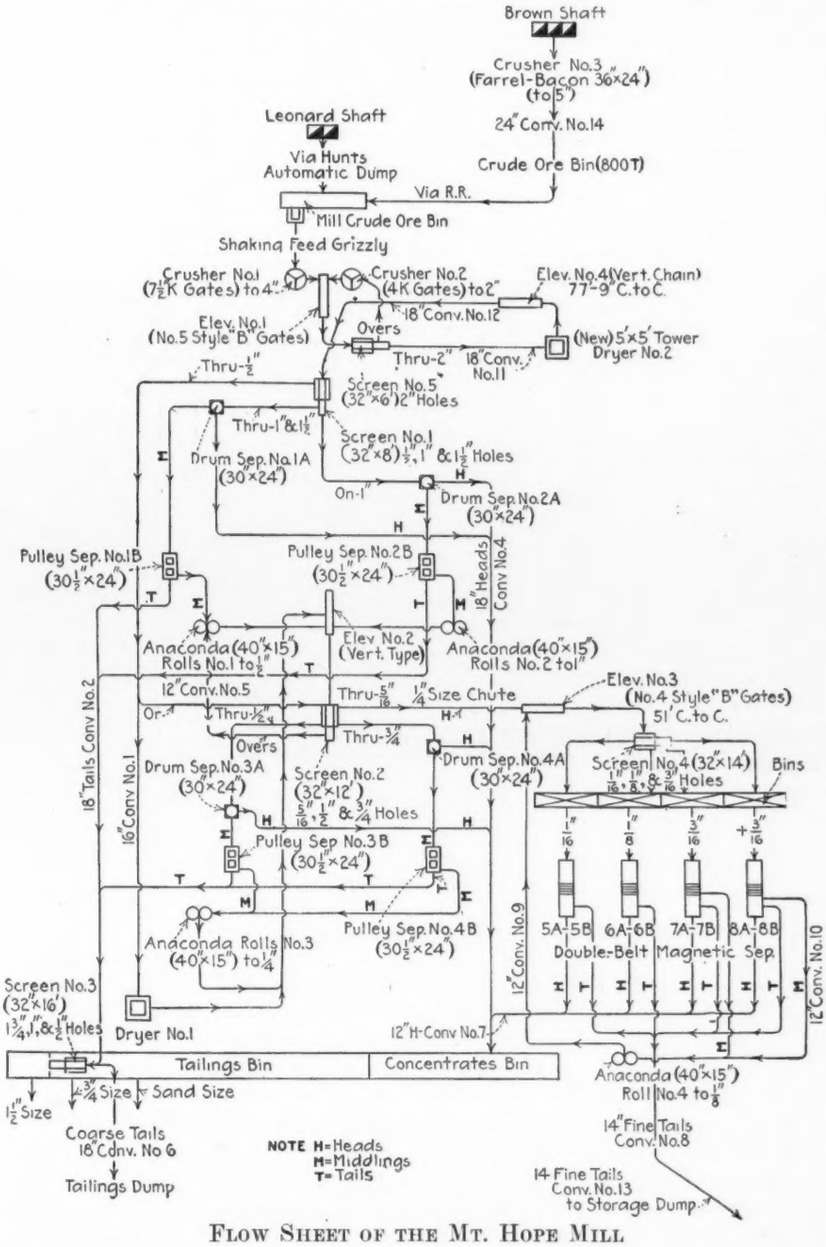
The middlings from pulley machines Nos. 1, 2, 3 and 4 are crushed in 40x15-in. Anaconda rolls Nos. 1, 2 and 3, set to ½ in., 1 in., and ¼ in. respectively, and pass from these rolls to the boot of elevator No. 2.

Elevator No. 2, which is vertical, being 45 ft. between head and foot wheels, is made up of one strand of No. 132 special combination chain fitted with K_2 attachments every second link. To these K_2 attachments are bolted 16x8x11¾-in. elevator buckets made of No. 8-gage steel plate. The head and foot shafts are provided with smooth traction wheels over which the chain rides. The elevator has a speed of 200 ft. per minute and a maximum capacity of about 200 tons per hr., but is never called upon to handle this amount of ore.

From this elevator the ore is discharged into trommel screen No. 2. This screen is 32 in. diameter by 12 ft. long and is made up of a dust jacket 48 in. diameter by 6 ft. long with $\frac{5}{16}$-in. round holes, an inside section 32 in.

diameter by 6 ft. long with ½-in. round holes and an end section 32 in. diameter by 6 ft. long with ¾-in. round holes. Four sizes are made by this screen as follows: Through $\frac{5}{16}$ in., which passes through a gravity chute to the boot of elevator No. 3 in the fines-separating department; through ½ in. on $\frac{5}{16}$ in., which goes to drum separator No. 3; through ¾ in. on ½ in., which goes to drum separator No. 4; and the oversize, on ¾ in., which goes by way of 12-in. belt conveyor No. 5 to rolls No. 1.

Drum machines Nos. 3 and 4, which are similar to drum separator No. 1, work, each, in combination with a pulley-type separator. The drum machine is located in each case above the tail pulley of a pulley-type separator, and makes a finished concentrate which is delivered by means of a gravity chute to the 18-in. belt conveyor No. 4. The middlings from the drum fall directly on the conveying belt of the pulley machine which makes a middlings product which is sent to rolls No. 3 and a tailings product which is delivered by a gravity chute to tailings conveyor No. 2. Drum machines Nos. 3 and 4 carry, each, 3.75 amp. at 250 volts, and the pulley machines Nos. 3 and 4 carry 12.5 amp. at 250 volts.



FLOW SHEET OF THE MT. HOPE MILL

FINES-SEPARATING DEPARTMENT

The fines-separating department is housed in a new five-story wooden building whose dimensions are 24x39 ft. by 55 ft. high. This building forms an annex to the old mill and was designed so that the main floors of each building would be at the same elevation. In structural design this annex is similar to the old mill building.

All ore finer than $\frac{5}{16}$ in. is received by elevator No. 3, which is located in the new annex. This is a No. 4, style B, geared-head elevator of Allis-Chalmers make. It is 52 ft. 4 in. between centers, and has an inclination of 84½°. The buckets, which are 13x10x7 in., are bolted to a 14-in. eight-ply belt which has a speed of 200 ft. per minute.

The elevator discharges into a 32-in. by 14-ft. screen. The screen is made up as follows: A dust jacket of No. 16 gage steel plate, 48 in. diameter by 4 ft. long, having ½x$\frac{1}{16}$-in. slotted holes; an inside section 32 in. diameter by 7 ft. long with ⅛-in. round holes; and an end section 32 in. diameter by 7 ft. long with $\frac{3}{16}$-in. round holes. This screen makes four sizes, namely, through $\frac{1}{16}$ in., through ⅛ in., through $\frac{3}{16}$ in., and an oversize through $\frac{5}{16}$ in. on $\frac{3}{16}$ in. There is a wooden storage bin situated on the floor below. The bin has four compartments, one for each size product from the screen. These compartments are each 4½x7½x 7 ft. inside and will hold, when full, sufficient ore to run the fines department for 1 hour.

On the floor below the bin are four double-belt magnetic-separating machines. Three of these machines are of the series type and one is of the parallel type. The finest size, through $\frac{1}{16}$ in., goes to the parallel machine, while the other sizes are treated on the series machines.

The parallel machine consists of two belt separators placed one above the other and operating in parallel. This machine makes concentrates and tailings but no middlings, as at through $\frac{1}{16}$-in. size there is not enough combined material to pay for further crushing. The parallel machine has about double the capacity of a series machine. Each belt separator is made up of 12 magnets connected in series and carries 4 amp. at 250 volts.

The series machines consist of two belt-type separators, one above the other. The top machines deliver clean concentrates and carry a current of about 5 to 5.75 amp. at 250 volts. The bottom machines carry 8.25 amp. and treat the rejected material from the top machines, making

middlings and tailings. Each belt separator is made up of 12 magnets connected in series.

The concentrates from the four double-belt machines are collected on 12-in. belt conveyor No. 7 which delivers its load to the main concentrates conveyor No. 4. The middlings from the three series machines are collected on 12-in. belt conveyor No. 10, which discharges into a set of 40x15-in. Anaconda rolls No. 4, set to ⅛-in. opening. The tailings from all four machines go through gravity chutes to 14-in. belt conveyor No. 8. This conveyor in turn delivers the fine tailings to the 14-in., motor-driven belt conveyor No. 13, which has a length of 200 ft. between head and tail pulleys. This latter conveyor discharges the tailings on the fine-tails storage dump. The product through rolls No. 4 is sent by means of 12-in. belt conveyor No. 9 to the boot of elevator No. 3.

Storage of Concentrates

All of the concentrates from the coarse and fine departments are collected by 18-in. belt conveyor No. 4. This conveyor is 107½ ft. long between head and tail pulleys and has a slope of 12° and a speed of 309 ft. per min. The concentrates are discharged into a 500-ton wooden storage and shipping bin, the inside dimensions of which are 15½ ft. wide by 30½ ft. long by 20 ft. high. The bin has a 45° bottom and joins the rock bin, which has the same dimensions.

To guard against the lack of storage for concentrates when shipments are not heavy and when it is still desired to keep the mine and mill working at either one or two shifts, a stocking conveyor and trestle with arrangements for reclaiming the ore were designed and erected. This conveyor is 18 in. wide and 360 ft. long between head and tail pulleys. It rises at an angle of 14° for 225 ft. and then is level for 135 ft. The level part is about 55 ft. above the ground, and is equipped with a hand-propelled, double-discharge tripper.

The inclined part of the conveyor is supported by a wooden trestle with bents spaced at 21-ft. centers. The level part is supported by a truss laid on four main bents at 45-ft. centers. All bents rest on concrete piers or sills. The machinery for the conveyor was supplied by the Stephens-Adamson Manufacturing Co. The belt used is an 18-in., five-ply, ⅛-in. rubber-covered "Maxecon," furnished by the B. F. Goodrich Co. The conveyor is driven through a set of spur gears at the foot pulley by means of a 15-hp. stationary steam-driven engine.

The method of operating is to allow the concentrates bin to fill and when the ore is at a fixed elevation the surplus passes through a gravity chute to the tail end of the conveyor and from this point on out to the storage pile.

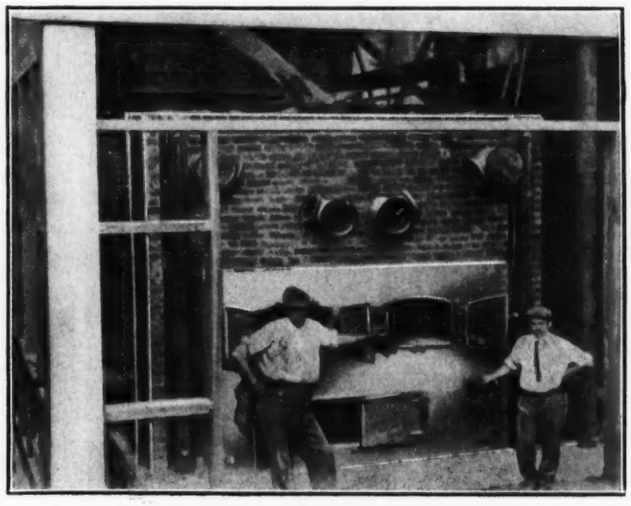
Reclaiming tracks are laid on both sides of the conveyor, with a spur for empties. In the course of stocking ore these tracks are covered up and in reclaiming ore use is made of a 1-yd. Hayward grab bucket. This bucket is attached to a 55-ft. boom, the latter with the hoist engine carried by a strong, home-made flat car having extra-heavy trucks. This car is pushed by the yard locomotive to any part of the pile. The maximum content of this stock pile is 30,000 tons.

Equipment and Power Summarized

The total crushing equipment is one Farrel-Bacon jaw crusher, 36x24 in.; one No. 7½K gyratory, one No. 4K gyratory and four sets of 40x15-in. Anaconda rolls. The separating equipment consists of four drum machines, four pulley machines and four double-belt machines.

The power equipment consists of one right-hand 16x36-in. heavy-duty Corliss engine rated at 300 continuous hp. at 140 lb. steam pressure, 100° superheat, and 100 r.p.m. This engine is belted to the 4 15/16-in. main mill shaft from which most of the machines in the old mill and those in the new dryer building are driven. The Brown shaft-crusher installation is driven by a Westinghouse motor rated at 100 hp., 550 volts, 850 r.p.m. The fines-separating department, as well as a few machines in the old mill, is driven by a Westinghouse motor rated at 100 hp., 550 volts, 333 r.p.m. The fine-tails conveyor is driven by a Westinghouse motor rated at 5 hp., 550 volts, 850 r.p.m. The exhaust fan at the top of the new dryer is driven by a motor rated at 5 hp., 550 volts, 400 r.p.m. The blower at the bottom of the new dryer is driven by a Peerless motor rated at 3 hp., 220 volts, 665 revolutions.

Direct current for the motors, as well as for the separators, lights and other power purposes, is obtained from a 550-kw. d.c. Westinghouse mixed-pressure turbogenerator. Through an interconnecting switchboard current may be obtained, if desired, for the magnetic separators and lights from a 35-kw. d.c. Bullock generator, direct-connected to a 9x10-in. simple automatic Ideal engine.



The New Dryer Furnace

The Corliss engine and the generators are in the engine room of the power plant, which is situated only a short distance to the west of the mill.

The switchboard controlling the magnetic separators is in a dust-proof room on the same floor as the machines, and is thus easily accessible to the mill foreman. This board is made up of three panels, and consists of a rheostat and switch for each machine. The board was designed with only two ammeters, thus doing away with the usual practice of having an ammeter for each magnetic separator. The 100-hp. mill motor with its starting panel is situated in a dust-proof room on the main separator floor.

As a precaution against fire, dry-pipe Grinnel automatic sprinklers have been installed in all the mill buildings and conveyor housings. A 2500-gal. storage water tank with a 20-ft. head above the top of the mill is connected by a 6-in. cast-iron pipe line to the sprinkler sys-

tem. The system was furnished and installed by the General Fire Extinguisher Company.

In accordance with its policy of safety the company has equipped the main mill shaft with a No. 230 solid Smith-type Hill friction-clutch coupling. This coupling is operated from three floors of the mill through a double-geared clutch operator. All dangerous places in the mill have guard rails or other devices to make the work as safe as possible.

Operating

The mill is operated for one or two eight-hour shifts per day, depending upon the demand for concentrates.

Headframe at the Brown Shaft

The mill treats about 500 tons per shift, the actual capacity being about 60 tons per hour when running on 40% ore. The richer the crude ore the greater the capacity, due to the smaller proportion of middlings returned for treatment.

Each shift employs 12 men as follows: One foreman, one feeder, one crusherman, two men on rolls, two men on separators, one man on screen floor, one man on new dryer, one fireman and two loaders. In addition to these men there are three others in the repair crew who make all repairs at the end of each day shift. At the Brown shaft crusher house there are two men.

Samples of crude, concentrates and tailings are taken and analyzed each day. The crude ore averages 40 to 48% iron; the concentrates average 58 to 60% iron; the tailings average 10% iron.

A complete analysis of average concentrates as shipped Mar. 1, 1915, is shown in the accompanying table:

ANALYSIS OF CONCENTRATES PRODUCED

Metallic iron, dried at 212° F.	58.000 to 60.000%
Phosphorus	0.550 to 0.650%
Sulphur	0.042 to 0.055%
Manganese	0.025 to 0.050%
Silica	8.000 to 10.000%
Alumina	1.250 to 2.000%
Lime	2.500 to 3.000%
Magnesia	1.500 to 2.000%
Copper	0.000 to 0.000%
Titanium	trace to 0.350%
Vanadium	0.035 to 0.075%

The construction of the new plant and redesign of the old mill were under the direction of the Mines Management Co., 60 Broadway, New York City; H. M. Roche, Superintendent for the Empire Steel & Iron Co.; and the writer, who was designing and metallurgical engineer.

Lake Superior Ore Shipments

The rail shipments from Lake Superior iron mines in 1914, as completely reported, were 707,829 long tons. Added to the water shipments this makes a total of 32,729,726 tons, a decrease of 17,217,290 tons from 1913. The division of the shipments by ranges, as compiled by the *Iron Trade Review*, was as follows, the table also giving the total shipped from each from its opening up to the end of 1914:

Range	Date Opened	Shipments 1914	Shipments Total	P.C.
Marquette	1850	2,491,857	109,790,676	17.0
Menominee	1877	3,221,258	83,266,269	12.9
Gogebic	1884	3,568,482	80,835,693	12.5
Vermillion	1884	1,016,993	35,846,066	5.5
Mesabi	1892	21,465,967	334,550,745	51.6
Cuyuna	1911	859,404	2,044,967	0.3
Baraboo	1903	105,765	1,442,744	0.2
Total		32,729,726	647,777,160	100.0

The total shipments in 1914 were lowest in any year since 1904, with the exception of 1908. The decline was on all the ranges with the exception of the new Cuyuna range. It was most marked on the Marquette and the Menominee.

For the third successive year the independent ore-mining companies shipped over half the tonnage, their total proportion being 50.99%, while the United States Steel Corporation had 49.01%. The total shipments of the Oliver Iron Mining Co. in 1914 were 16,039,654 tons. Of this 6,013,758 tons were from the Hill leases, which terminated with 1914. This quantity was just over the agreed minimum for the year.

Only four mines shipped over a million tons in 1914, the Leonard, Mahoning, Sauntry-Alpena and Canisteo. The Hull-Rust, which was the leading shipper for several years, reporting 3,457,608 tons in 1913, shipped only 458,468 tons in 1914. The change was not due to any exhaustion, but to the diversion of work to the Hill leases. The Leonard was the leading shipper last year, with 2,686,685 tons.

There were 16 new mines shipping in 1914. Ten of these were on the Mesabi, four on the Menominee, one each on the Gogebic and the Cuyuna range. There were in all 196 mines from which shipments were made last year.

Canadian shipments, not included above, were 80,860 tons from the Helen mine on the Michipicoten range; 98,070 tons from the Magpie, and 29,457 tons from the Moose Mountain—a total of 208,387 tons.

Carnotite near Mauch Chunk

By W. B. Richards*

Carnotite was first discovered in the anthracite region in 1902, at Mauch Chunk, Carbon County, Penn., within seven miles of the point at Summit Hill where coal was first discovered in Carbon County by Philip Ginter in 1791. This carnotite was discovered on a ledge of conglomerate rocks in the transition strata between the Mauch Chunk red shale and the Pottsville conglomerate, at a point about one-half mile west of the bridge crossing the Lehigh River to East Mauch Chunk and on the south side of the Eastern Pennsylvania R.R. where a railroad cut was made by blasting away the mountain side.

It appears in green and canary-yellow daubs or splashes on the rock, and in the crevices where foreign matter was deposited such matter is thoroughly impregnated with it. Unfortunately these crevices are only from 1 to 2 ft. long and not more than an inch wide.

By drilling in this formation in the anthracite region, crevices filled with foreign matter and impregnated with carnotite may be discovered in sufficient quantity to pay to develop. To be profitable it is required that the rock in which carnotite is found should contain about 2%. Samples of this ore were sent to R. B. Moore, Physical Chemist, Bureau of Mines, Experiment Station in Colorado. He analyzed it and reported that not only was the yellow material carnotite, but the ore also carried apparently some vanadium which is usually associated with carnotite in addition to the actual vanadium in the yellow material itself.

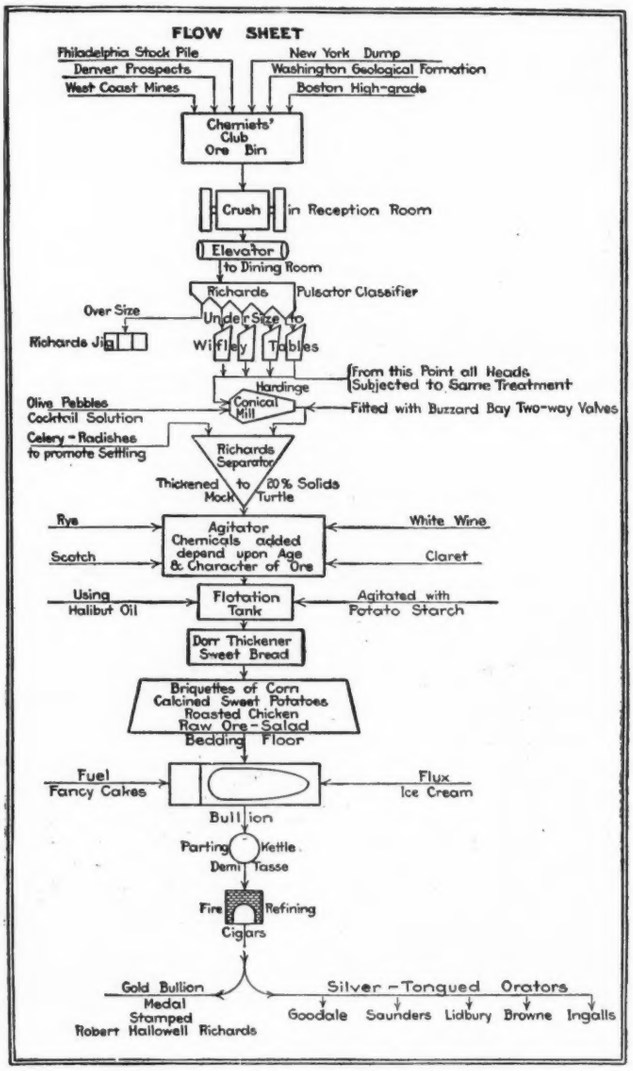
Alaska-Ebner

Unless an extension is secured, the Alaska-Ebner property at Juneau is to be sold under foreclosure on Mar. 31, to cover advances amounting to about $500,000, made by the U. S. Smelting, Refining & Mining Co., during the life of its option. On Dec. 14, 1914, the Smelting company notified the bondholders protective and reorganization committee (generally known as the Chapman committee) that to justify proceeding with the plan of reorganization it would be necessary to find ore in sufficient quantity to show a recoverable value of $15,000,000, that such amount had not been found at that date and that the Smelting company desired the return of its money, with interest, on Feb. 15. This date was extended first to Mar. 10 and then to Mar. 31. The Chapman committee has not been able to secure a satisfactory promise from the bondholders regarding the raising of the necessary $500,000, and two propositions have been suggested: First, to pay the Smelting company $100,000 for an extension until July 10, 1915, and an option on 49% of the property for the amount of its obligation, i.e., $500,000; or to pay $200,000 for the extension to July 10, 1915, and have the option on the entire property upon the repayment of all advances. Thus the Smelting company would, under the first proposition, receive a profit of $100,000 for its advances and $200,000 in the case of the second proposition. The bondholders, in order to recover the property, must pay approximately $500,000 on Mar. 31; or $100,000 on Mar. 31, and $500,000 on July 10, 1915, for 49% of the property; or $200,000 on Mar. 31 and $500,000 on July 10, 1915, for the entire property. The committee hopes to secure an extension of four months in order to determine the present value of property. In the recent circular to bondholders, no statements are made as to what value has been disclosed by the developments of the Smelting company.

*Mining engineer, Lansford, Penn.

The Richards Dinner

The annual presentation of the gold medal of the Mining and Metallurgical Society of America took place at the Chemists' Club in New York on Thursday, Mar. 18. The award this year was made to Robert Hallowell Richards for distinguished service in the advancement of the art of ore dressing. A poem, written by Berton Braley for the occasion, runs as follows:



Richards Dinner Flow Sheet

Here's to you, Bobby, O sage metallurgical,
You who have taught us much wisdom of yore,
Doctor of Dressing—not salad or surgical—
But of the dressing of every old ore.
Long may you flourish in all your variety,
You whom we're proud to be honoring now!
Robert H. Richards, this mining society
Slips you the laurel to wear on your brow!

Tickle the harp with pulsations harmonious,
Jig-time pulsations, for jigs are his forte;
Lift up your voices in noises euphonious,
Praising the man we call "Bobby" for short.

Teacher and author of top-notch ability,
Chief patriarch of the ore-working clan,
Mighty inventor of great versatility,
Thinker, and dreamer and Regular Man!

Gladly we boost you in accents vociferous,
Robert H. Richards, for clearly we know
You are of ore which is purely auriferous;
Tests by the hundreds have proven you so;
Up with the glasses, we drink to you merrily;
Long may you wave!—like the Red, White and Blue,
There's a warm spot in our hearts for you, verily,
Bobby, oh, Bobby—here's looking at you!

After the dinner—flow sheet of which is herewith shown—presided over by Mr. Ingalls, there were speeches by W. L. Saunders, F. A. Lidbury, Charles W. Goodale, David H. Browne, a presentation speech by W. R. Ingalls, and the response by Robert H. Richards. Mr. Saunders, as president of the A. I. M. E., represented the miners; F. A. Lidbury, president of the American Electrochemical Society, represented the allies called in by the old-fashioned metallurgist; Mr. Goodale represented the ore dressers and smelters, while David H. Browne spoke as the man who had taken a fall out of the blast furnaces and rendered the reverberatory supreme.

Phelps, Dodge & Co.

The report for 1914 shows that the constituent companies controlled by Phelps, Dodge & Co. produced 140,231,384 lb. of copper, of which 8,569,060 were made from the Miami Copper Co.'s ores, and the resulting blister copper delivered to Miami. Including copper received from outside sources, Phelps, Dodge & Co. marketed 188,687,387 lb. of copper at an average price of 13.57c. per lb. net cash f.o.b. New York. Of this amount over two-thirds was delivered in the first seven months of the year.

During the year Phelps, Dodge & Co. purchased the Tombstone Consolidated Mines Co. and other properties in the Tombstone district, which will be operated in future as one of the Phelps-Dodge constituents under the name of Bunker Hill Mines Co. The total copper ore extracted from all of the company's mines was 1,777,243 tons, of which 1,046,728 tons were concentrated and 730,515 tons smelted direct. The total amount of copper-bearing materials smelted, including ore, concentrates, old slag and cement copper, was 917,204 tons. The bullion produced carried 26,259 oz. of gold and 1,405,301 oz. of silver. In addition there were produced and sold 23,930 tons of lead ore from the Copper Queen mine, yielding 399,106 lb. of copper, 8,889,175 lb. of lead, 332,137 oz. of silver and 1822 oz. of gold, and from the newly acquired properties at Tombstone, 1937 tons of ore yielding 1586 lb. of copper, 46,899 lb. of lead, 32,188 oz. of silver and 437 oz. of gold. Of the ore and concentrates smelted, 855,594 tons was derived from the company's property and 61,610 tons was custom ore.

The Stag Cañon Fuel Co. mined 1,355,938 tons of coal, of which 495,127 tons were consumed in the manufacture of 239,966 tons of coke.

The total production from the Copper Queen mine was 732,829 tons of ore, carrying 8,889,175 lb. of lead, 86,066,143 lb. of copper, 1,036,672 oz. of silver and 15,769 oz. of gold. The Copper Queen reduction works treated 835,016 tons of ore, carrying 119,957,017 lb. copper, 1,405,301 oz. of silver and 26,259 oz. of gold. This reduction works increased its stock of ore on hand by 27,359 tons during the year. The development of several million tons of concentrating ore in Sacramento Hill necessitates erecting a concentrator by the Copper Queen company. A small test mill of 90 tons capacity per day has been constructed. The best results were obtained by combining hydraulic and flotation methods, flotation increasing the recovery by about 12% and making a total saving of about 87%. Experiments are also under way for the treatment of the slimes produced by the various concentrators of the Phelps-Dodge company.

The Morenci works of the Detroit Copper Mining Co. treated a total of 477,582 tons of material producing 20,274,367 lb. of copper. The average grade of all the ore mined during the year was 2.92% of copper. The milling ore averaged 2.79% copper.

No figures are given as to the ore mined by the Moctezuma Copper Co., but the concentrates, slimes and small miscellaneous shipments of gold ore came to a total of 122,764 tons, carrying 32,229,211 lb. of copper, 435,482 oz. silver and 1006 oz. of gold. The operations of the railroad have been interfered with several times during the year for the movement of troops, but relations with the various factions in Mexico have been uniformly pleasant.

The Burro Mountain Copper Co. has continued experiments on the treatment of its ores. The erection of the mill was suspended, but the experiments have proved sufficiently encouraging to justify the resumption of the construction of a mill with a capacity of 1000 tons per day. The results at the experimental mill show a gradual improvement in extraction from 53.90% in May to 79.8% in December. During the year the first 1000-hp. internal-combustion unit (Diesel type) was started. A second engine is now being erected.

Funds for the U. S. Geological Survey

The sundry civil act as passed by the last session of Congress contained appropriations of $1,355,520 for the U. S. Geological Survey. Most of the appropriations for the Survey are included in this great Government supply bill, but in addition to the above-stated amount $40,000 was appropriated in the legislative bill for rents, so that the total amount appropriated is $1,395,520. The principal items in the appropriations for the Geological Survey for the fiscal year ending June 30, 1916, are as follows:

Topographic surveys	$350,000
Geologic surveys	350,000
Mineral resources of Alaska	100,000
Mineral resources of the United States	75,000
Chemical and physical researches	40,000
Geologic maps of the United States	110,000
Gaging streams, etc.	150,000
Surveying national forests	75,000

The bill also appropriates $175,000 for printing and binding Survey reports, to be expended by the Public Printer, and $1,500,000 for the new Interior Department building, which is to accommodate the Office of the Secretary of the Interior, the Geological Survey, the Reclamation Service, the Land Office, the Indian Office, and the Bureau of Mines, all bureaus of the Interior Department whose work is closely related to that of the Survey and among all of which there is more or less constant cooperation. The total cost of the new building has been fixed at $2,596,000.

Aluminum Precipitation at Nipissing

By E. M. Hamilton*

SYNOPSIS—A discussion of the method of precipitation in use at the Nipissing low-grade mill, which has been the subject of some criticism. The difficulties attendant upon the use of zinc are shown, and the economies—metallurgical and monetary—are explained in detail.

This article is offered as a continuation of the discussion on the paper by James Johnston, presented at the New York meeting of the A. I. M. E., February, 1914, on the mill and metallurgical practice of the Nipissing Mines Co. at Cobalt, Ont., and deals with the review of that paper made by Prof. G. H. Clevenger at the Salt Lake meeting in August, 1914. I shall, moreover, confine my remarks to that part of the review dealing with aluminum precipitation.

Aluminum Dust to Replace Zinc Dust

Starting with the reasons that led to the adoption of this process at the Nipissing, I do not think there was any statement in my article published in the Journal of May 10, 1913, necessarily inconsistent with the views expressed by Mr. Clevenger, that "zinc precipitation *under proper conditions*" (the italics are mine) "would not have been impossible in the cyanidation of Nipissing low-grade ore." I would point out that the particular difficulties connected with the use of zinc as a precipitant, which I explained in detail, only began to be apparent a few weeks before the new mill was expected to start crushing. Finding an alternative method at hand in the aluminum dust, which we proved to be free from the objections attaching to zinc and only slightly more expensive to work, it seemed the obvious course to install that method, rather than consume time and money in the careful investigation which Mr. Clevenger admits would have been required in order to find some way to get around the drawbacks attendant on zinc, an investigation, moreover, which did not appear to us to promise success.

Zinc Prejudicial in Some Cases

That the presence of zinc in stock solutions has been found to affect extraction adversely in the case of other ores than those of Cobalt, I can testify from personal experience. At one mill in Mexico I found that the activity of the stock solution could be improved so as to yield several per cent. increase in silver extraction by precipitating as much as possible of the zinc with sodium sulphide. This series of experiments was not carried beyond the laboratory stage, but at another mill I visited we found it a substantial aid to the extraction of silver from certain kinds of ore to treat the whole of the barren solution periodically with sodium sulphide, so as to keep the zinc content down below a certain figure. I may remark that neither of these results was due to an unrecorded increase in free-cyanide strength arising out of a regeneration of free cyanide from the zinc compound (an increase which might well escape observation under the KI method of titrating), because in every case solution strengths were maintained constant in terms of free cyanide, as determined without the use of KI indicator.

The most notable instance I have come across, however (with the exception of the Nipissing), was in the early part of 1912, in the case of some ore from the state of Oaxaca, containing, among other refractory minerals, arsenic and antimony compounds.

The experiment made to investigate the effect of reusing the solution from the precipitation of the silver by zinc dust showed a drop of nearly 10% in extraction. The solution was used over six times, although after the third time the deleterious effect appeared to have reached its maximum.

RESULT OF USING OLD SOLUTION
Head Assay of Ore, 803 Grams per Metric Ton
Residue Assays

	Residue	Extraction
Using new solution	127 grams	84.1%
Using old solution	202 grams	74.8%

It may be objected that in this experiment the deterioration is not proved to be due to zinc because I did not try the effect of the same old solution after throwing down the zinc. As the time available was limited, and as I did not then know about the aluminum-dust process, I contented myself with suggesting that after the mill was running experiments should be made with a view to throwing out the zinc with sodium sulphide, because, in the light of my previous experiences, I had no doubt then, nor have I now, especially with the added evidence derived from Nipissing, that the loss of 10% in extractive power of the solution was due to the use of zinc as a precipitant in the presence of deleterious substances dissolved out of the ore.

It is worthy of note that in most cases where zinc in solution appears to be detrimental I have found that lead also has a similar effect, and that it is impossible to use it as an aid to extraction of such ores.

Zinc Usually Used without Bad Results

Notwithstanding the special instances mentioned, however, I am prepared to admit that in regard to the great majority of ores I have had to do with, zinc in solution is not in any way detrimental, and that tests made between plant stock-solution and freshly made solution show no difference whatever in extraction. It is thus apparent that in discussing the advantages or otherwise of aluminum over zinc as a precipitant the question of differences in extraction will not, in most cases, enter, and that if the former is to take the place of the latter in the treatment of ordinary ores the reason must be sought on other grounds. Although the idea of aluminum precipitation was evolved over 20 years ago, so little work has been done on it that it is only during the last few years that it has been recognized as possessing any special advantages. How far those advantages may warrant a more extended application of the process is a matter that can only be determined by time and experiment.

Relative Cost of Aluminum and Zinc Processes

In seeking to answer this question, Clevenger puts forward three points for inquiry. He asks: "First, is aluminum-dust precipitation cheaper than zinc? (Of

*Metallurgical engineer, 50 Church St., New York.

course, in this connection we must give due consideration to all factors, even those having an indirect bearing on the subject.) Second, is there any function which it would not perform and which zinc does? Third, is it as effective for dilute solutions containing a small proportion of metal, such as is often encountered in treating low-grade gold ores?" I will try to answer these queries and will discuss them in the reverse order.

Aluminum as a precipitant is not so effective as zinc for solutions very low in metal, such as may be derived from gold ores; in fact, my experiments would tend to show that where solutions contain only gold in ordinary proportions precipitation is imperfect, unless a prohibitive quantity of the reagent is used. In my opinion it is doubtful whether there is any field for the method in the treatment of all-gold ores.

It is true that in cases where lead compounds have been found an aid to dissolution of the silver—though this is by no means a universal rule—such addition is often rendered unnecessary by the use of zinc as a precipitant, so that this question resolves itself principally into one of costs, except in such extremely rare instances as that quoted from Mexico. In considering the relative costs of the two processes at individual plants there will, no doubt, arise instances where the zinc process will have to be credited with a saving in lead salts.

Ultimate Profit the Deciding Factor

The whole discussion really turns on the answer to query No. 1: Is the use of aluminum-dust precipitation likely to result in a greater final profit than the use of zinc, at other mines than the Nipissing? At the latter mill under conditions there obtaining, and in the present state of our knowledge of the subject, Mr. Clevenger will, no doubt, agree that the use of the process is justified. There are also, I think, more than a few silver ores in other parts of the world whose behavior would approach, in a greater or less degree, to that of the Nipissing, and where, pending the discovery of "the conditions governing the separation of undesirable impurities from solution during and after precipitation," looked for by him, it may confidently be predicted that the use of aluminum as a precipitant will show a large margin of profit over zinc. Such instances we will therefore have on one side. We will also rule out of the discussion those ores containing only or principally gold, in the precipitation of whose solution I do not think aluminum is destined to find a field. There remains, then, the large class of silver and silver-gold ores with silver contents ranging from 8 or 10 oz. up to 20 or 30 oz. in the cyaniding of which the presence of zinc in solution is not detrimental to extraction. The two main factors to be considered are the operating costs and the savings, if any.

Operating Costs

As the zinc process was never used in the Nipissing low-grade ore mill, we cannot say positively what the zinc consumption would have been. I note that my estimate of 0.1 lb. per oz. of silver is a little higher than the figure given by Clevenger for practice in the Pachuca district—viz., 1 lb. of zinc dust per lb. of fine bullion, or 0.07 lb. per troy oz.; but I am quite willing to accept the lower figure. For aluminum dust we must continue to take the consumption I gave in my paper, 0.02 lb. per oz. of fine silver, for lack of definite figures showing an improvement over this consumption elsewhere.

I must, however, question the validity of the generalizations on the cost of the process derived from the stated charge for aluminum dust at the time my paper was written. First of all, there is the Canadian duty of 15% *ad valorem,* which would not apply outside that country, the deduction of which would reduce the price at that time to 30c. to 35c. per lb. Since early 1913, however, the price has dropped, and at the beginning of 1914 many tons were bought for shipment abroad at 25c. Should the demand increase, there is no reason why we may not look for a further reduction. As an example, take the price of cyanide. When I began working with the cyanide process it was somewhere around 50c. per lb. Anyone who had then tried to define the future scope and general applicability of the process on the basis of 50c. per lb. for cyanide would today be a long way from the truth. Nevertheless, since 25c. is about the lowest that aluminum dust has hitherto reached, we must, for the present, assume that figure, giving the following comparison:

Aluminum	0.02 lb.	at 25c.	=	$0.005 per oz. Ag
Zinc	0.07 lb.	at 7c.	=	$0.0049 per oz. Ag

This on a 10-oz. silver ore would give a difference of only 1 mill per ton in favor of zinc.

In addition to the cost of aluminum, we have a charge for caustic soda which does not apply to the zinc process. At the Nipissing this has been estimated at $0.0016 per fine oz. of silver; but under other conditions the consumption would be far lower. Mr. Clevenger is under a misapprehension when he states that it is necessary to add caustic just prior to precipitation. At the Nipissing no addition of caustic is made at any stage of the cyanide treatment. The only caustic present at the time of precipitation is that carried over mechanically from the desulphurizing process and the small amount that may be derived from decomposition of cyanide during treatment. The amount so carried over is far more than sufficient for precipitation purposes, averaging, as it does, about 0.15% NaOH. I have found in my work at another mine that 0.05% NaOH is amply sufficient to give good results and allows of better control than a higher strength. This will cut down the consumption of caustic probably nearly two-thirds, but to be on the safe side we will say one-half. Thus, one estimate for its consumption will stand at $0.0008 per fine oz., or for a 10-oz. ore 8 mills per ton.

The extra cost of aluminum over zinc precipitation will now stand as follows for a 10-oz. ore:

Extra cost of precipitant	$0.001
Cost of caustic soda	0.008
Total	$0.009

or, roughly, 1c. per ton.

Stearinized Aluminum Dust

As regards the power used, the principal item is the pumping of the solution into the press, which will be the same for both processes. The additional power for the two little agitators to mix the aluminum dust is so small as to be negligible. I may here remark that Mr. Clevenger exaggerates the difficulty of mixing this dust. With the apparatus worked out at the Nipissing there is no trouble whatever on this score. Moreover, the coating of stearin does not appear to be a detriment, as supposed by him, but rather an advantage. It is possible to obtain un-

burnished dust almost entirely free from stearine, and such was tried at the Nipissing as long ago as the summer of 1913; but Mr. Johnston informed me that while it is more rapidly wetted than the other, it tends to pack in the feeder, necessitating more attention and resulting in an irregular feed and higher consumption, so that its use was discontinued in favor of the stearinized product.

Sources of Economy in Aluminum Dust

There are two avenues for saving in expense due to this process. There is a saving in fluxes and fuel in melting the precipitate, which, working with a clean ore, is usually so fine that it can be melted direct in an oil-fired furnace without any flux and without any preliminary acid or other refining. I am not prepared to estimate the amount of this saving, but it will usually be sufficiently important to have a bearing on the question we are discussing. There is also a saving in cyanide. This is the point opposed most strongly by Clevenger; but on the debit side of the account we have only 1c. per ton against aluminum, so anything we can show on the credit side over 1c. per ton will represent profit for the new process.

Regarding the estimate of the cyanide recovered in the case of aluminum, he is right in supposing that this was based on head-and-tail titrations, and I fail to see any objection to this method. The titration is not open to the variations and inaccuracies that arise when zinc is present, and the results so obtained check almost exactly with the theoretical figures based on the amount of silver liberated. Nor do I see why one need assume that the cyanide shown in this way to be freed from combination is any less effective than the original cyanide. He suggests, it is true, that the amount shown may not be all gain, quoting Julian to the effect that alumina (referring, of course, to the hydroxide of the metal), when precipitated out of a cyanide solution, carries down a large proportion of the cyanide present. Those experiments were made many years ago and conditions have changed so much since then that one would need some definite evidence from various observers under modern working conditions before assuming that such a tendency would be sufficiently marked to constitute an appreciably interfering factor. Secondly, he assumes that alumina in such circumstances is bound to be precipitated, but I fail to see the necessity, because in the presence of sufficient free alkali it will remain in solution as sodium aluminate, and the amount of aluminate so held in solution would never increase beyond a certain point, owing to a part of the stock each day being lost in the form of moisture in residues. Thirdly, aluminum compounds if precipitated out of such solution, are not necessarily—and as a rule probably are not at all—precipitated as aluminum hydroxide, because we know that when they come in contact with fresh lime they are thrown down as calcium aluminate, a white, earthy substance entirely different from the hydroxide. I note that Mr. Clevenger questions Kirkpatrick's conclusions that the use of dust overcomes most of the difficulties experienced by the early experiments; but in so doing he seems to have missed the point of Julian's crucial difficulty, which was not so much the fact that alumina was thrown down as that it was deposited on the metallic precipitating surface and stopped further action. The use of dust instead of plates or shavings would obviously overcome Julian's main trouble, because any given particle of dust would have done its work and become dissolved long before it could accumulate a coating of alumina sufficient to prevent further action.

Loss of Cyanide through Alumina

Regarding the important question as to whether, in practice, any appreciable quantity of cyanide is actually carried down mechanically by precipitated alumina and thus lost, investigation is difficult in the case of an individual ore charge, but a guess may be made by surveying general conditions of cyanide consumption over a considerable period, and I think that, at the Nipissing at any rate, the question may reasonably be answered in the negative. In the large-scale tests Mr. Clevenger made there, his average head assay was 40 oz. of silver; he recovered 44.2% by amalgamation, leaving only 47.9% or 19 oz. actually extracted by cyanide. His cyanide consumption averaged 8.5 lb. per ton, chemical loss—that is, without allowing for mechanical loss in the form of moisture in residues. (These figures are all stated in terms of 99% cyanide.)

In J. J. Denny's experiments on the desulphurizing process the cyanide consumption on similar ore, after having undergone the preliminary treatment, averaged 7 lb. per ton chemical loss. His experiments were carried out without removing the metallics, which were ground up with the pulp prior to desulphurizing, and conditions corresponded closely with those that obtain in the present low-grade mill, except that aluminum precipitation was not used.

Now turning to the actual cyanide consumption under working conditions we find that with a head assay of 29 oz. and a strength of 0.25% the average amount of cyanide used during the last 12 months (and it was almost the same when I was there two years ago) was only 5 lb. per ton, including loss in residues. This mechanical loss is stated by Mr. Johnston to be about 1 lb. per ton of dry ore, so we are left with a total chemical consumption of 4 lb. per ton, as against 7 lb. in Denny's preliminary experiments and 8.5 lb. in Clevenger's. The difference between the last two may probably be accounted for by the fact of the preliminary desulphurizing, though this process usually involves sending over a quantity of aluminum salts into the cyanide treatment, which according to the theory propounded ought to result in a heavy loss of cyanide. The difference, however, between Mr. Denny's preliminary tests and the actual working-plant figures cannot be accounted for in the same way, and moreover in the latter we have a considerable increase in aluminum compounds in solution, derived from precipitation, which ought by this theory to militate against a low cyanide loss. The decrease in cyanide consumption shown on a working scale is probably due to several causes, and I am not trying to attribute it entirely to aluminum precipitation; but my point is that the facts being what they are, there is not much margin for any very heavy loss of cyanide by absorption, as suggested by Mr. Clevenger.

Regeneration of Cyanide through Zinc

Coming now to the matter of zinc precipitation and the possible regeneration of part of the combined zinc double cyanide, I want to say before I go any further that when I based my estimated saving of cyanide on an assumption of the total loss of all cyanide that had once entered into combination with zinc I went beyond what

was warranted by the facts, and that Clevenger's criticism of this position was perfectly justifiable. It was more of an oversight on my part than anything else, because I have always contended (against those who deny it) that there is, or may be, a considerable amount of regeneration, or at least temporary dissociation of free cyanide from the double zinc compound, due to addition of free alkali. As a matter of fact, the sentence from my article quoted by him was expressly worded so as to meet his objection and allow for a partial regeneration, when I said, not "cyanide combined with zinc," as he quoted me in his next paragraph, but, "the cyanide that remains combined with zinc," meaning that which remains in combination after the regenerating effect has reached its maximum and emphasizing my belief that the double zinc cyanide, so long as its members remain locked in combination, has almost no solvent action on silver compounds.

It is for this latter reason that, for estimating the dissolving efficiency of a solution, I prefer the titration without KI indicator. I do not agree with Mr. Clevenger that the KI indicator method is just as good, provided that one knows the usual ratio of free to total cyanide on a particular mill, because that ratio is not constant, either between mine and mine or even from day to day on the same mine, as I have had occasion to observe. Neither do I agree with him that the first faint opalescence without KI is any more difficult to determine than the yellow end point of KI. I will even go further and say that I have known mills where, owing to more than ordinary amount of zinc in solution, it was much more difficult to get a consistent and uniform end point by the use of KI than it was without it. I believe that the instances one hears of now and again of the treatment going wrong in certain plants without any apparent reason might often be accounted for by this habit of titrating to yellow opalescence with KI indicator.

Fallacy of the Results with Iodide Indicator

To illustrate the point I am trying to make, let us take an extreme case. Let us suppose that we are treating an ore carrying traces of zinc; the proportion of the latter remains constant for a month or two, and consequently the ratio of free to total cyanide in the stock solutions is also fairly constant, and extraction is uniformly good. Suppose that one day a certain stope in the mine runs into a pocket of ore containing an appreciable amount of zinc soluble in cyanide. The metallurgist has always controlled his solutions by the KI titration, and he has found that a working solution of total cyanide strength of, say, 0.3% has given him his maximum extraction. Such a solution may contain only 0.15% of free cyanide, but he does not care anything about that. He may have ascertained the ratio at some time or other, or he may not; anyhow, he does not check it day by day. As soon as the bunch of zinky ore is run in on him (usually without a word of warning from the mine boss), what happens? His ordinary titration shows that his solutions are well up to 0.3% total cyanide, and therefore ought to do the same work as usual; but unknown to him the free cyanide has dropped to 0.1%, or 0.05%, or even down to nothing. After a few days he begins to get residue assays which show that his extraction has dropped appreciably. He is mystified and starts a hunt for trouble. Perhaps it takes him several days or weeks to find the reason, and then several more days to put it right. He finally straightens it all out—but at what a cost to his company! If he had been titrating in terms of free instead of total[1] cyanide he would have known in the first 12 hours that something abnormal had happened, and would have taken steps to put it right, and thus saved his company many thousands of dollars.

I have already admitted the fact of the recovery of part of the cyanide apparently lost in zinc precipitation, but, as Clevenger allows, the proportion that becomes available for further work by coming in contact with fresh alkali or other reagents and being dissociated is difficult to trace and must vary considerably according to circumstances. I am sure, however, that even he would not maintain that it is all thus recoverable, because if so, the head solutions to precipitation would never contain the zinc double cyanide, whereas in my experience, even where the alkalinity is maintained at over 0.1%, the double compound is always present in considerable amount, often being equal to the percentage of free cyanide. If, then, it is conceded, as I think it must be, that in the case of zinc precipitation not all of the cyanide entering into combination with the zinc is subsequently liberated and rendered available, we have here an opportunity of effecting a saving in cyanide by the substitution of aluminum.

I admit that in the present state of our knowledge of the process the advantage of its application in the case of low- and medium-grade nonrefractory silver ores is more or less hypothetical, and I fully agree with the dictum that the only way to know definitely is to run a competitive test against zinc precipitation on a working scale and over a fair period of time; but I submit that the chances of such a test being made are not assisted by smothering the new process, before trial, with objections which are, after all, mainly theoretical.

[1] I have treated the result of titrating with KI indicator as giving "total" cyanide because when the protective alkalinity is over 0.08% or thereabouts the reading so obtained coincides exactly with the standard test for total cyanide.

Refractories in the Glass Industry

Resistance of tank blocks and glass pots to the action of fluxes depends more upon physical structure than on chemical composition, says C. W. Berry (*Trans. Am. Ceram. Soc.*, abstr. by *Journ. Soc. Chem. Ind.*). A block should possess sufficient density to prevent the penetration of fluxes. It should dissolve slowly in the glass without causing "stones," and the wearing surface should remain smooth. Pure nonplastic clays which are attacked only slightly by fluxes must be introduced in a very fine condition, as otherwise the plastic binding clay will dissolve, allowing the refractory clay to enter the glass and form "stones." Blocks high in silica—e.g., where free silica has been added to obtain 77% SiO_2 in the finished product—are quickly destroyed, as also are mixings high in alumina. High silica also tends to increase porosity. It is not advisable to introduce "grog" made from used pots, as the material has absorbed fluxes which will cause a honeycombed surface. The greatest wear on a pot occurs during the first four melts; after the fifth, the action diminishes, as the pot becomes nearly vitrified. A pot which is suitable in composition for plate glass may not answer for lead and other glasses made in closed pots.

Details of Practical Mining

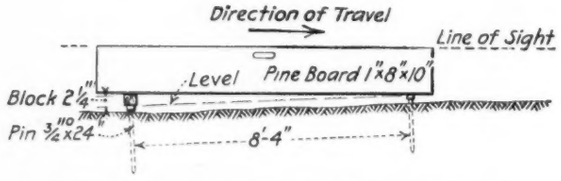
Grade-Board for Steam-Shovel Use

By L. B. Pringle*

The illustration shows a grade-board used extensively in steam-shovel mining around Hibbing, Minn. The novel feature of the device consists in the fact that the measurements are so adjusted that the terms "per cent." and "inches" are interchangeable.

The necessary equipment consists of a board, 1x8 in. by 10 ft., having its two edges carefully planed and parallel; of one small carpenter's spirit level, of two round iron pins ¾x24 in., having standard flat bolt heads, and of a supply of wood suitable to cut into small blocks of various thicknesses. A handle 1x1½x5 in. may be cut in the board to facilitate carrying.

The pins are spaced exactly 8 ft. 4 in. apart, parallel to the direction of travel of the shovel, and are driven close to the ground. By means of the board and level the pins are brought to the same elevation. Then for down grades a grade block is placed under the board on top of the rear pin; for up grades, under the board on top of



Grade-Board for Steam-Shovel Use

the front pin. The following table will show how simple is the cutting of the blocks:

For 1.0% grade use 1-in. block;
For 1.5% grade use 1½-in block;
For 1.75% grade use 1¾-in. block;
For 9.0% grade use 9-in. block;
For 0.5% grade use ½-in. block.

The illustration shows the application of the method in running a 2.25% down grade. The shovel runner sights along the upper edge of the board at a graduated stick or rule held upright by a helper at various points along the line, and knowing the depth below grade he is to carry throughout the course, and the height of the top of the board above the ground, he can readily ascertain the depth of cut needed at any point.

The percentage of error increases with the length of sight taken from a set-up; but I have found that by making two and sometimes three set-ups a day the error found by checking with the engineer's leveling is so small that it can be disregarded.

The Present Shortage of Mine Timber in England appears to be having one beneficial effect in that it is now possible profitably to thin certain forests to their great advantage, while this could not be done before remuneratively, owing to the competition of foreign timbers.

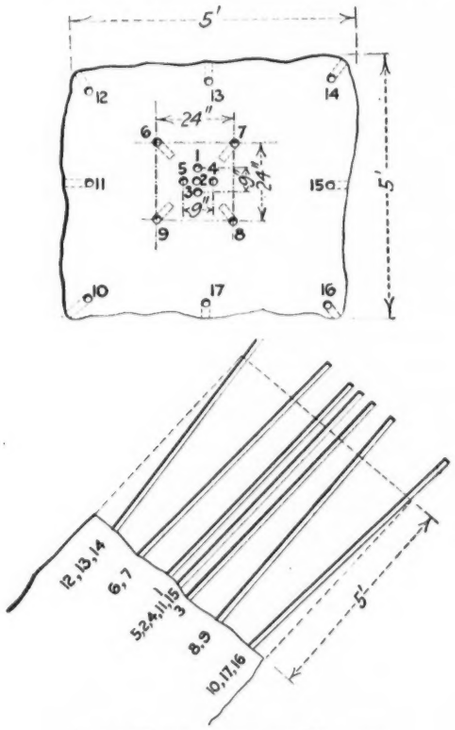
*221 East Washington Blvd., Ft. Wayne, Ind.

Five-Hole-Cut Raising Method

H. H. Hodgkinson*

The five-hole-cut method here described has proved to be the best and most economical method for both drifting and raising at the New Jersey Zinc Co.'s mines at Franklin Furnace, N. J., where the ore and limestone as a rule are soft.

Although this method necessitates drilling a few more holes than either the draw- or the V-cut method used in



Five-Hole-Cut for Raises

the West where the ground is hard and brittle, yet it can be depended upon to break a good clean heading in either ore or limestone. These other methods fail unless an excessive number of holes are drilled, which takes more powder, for due to the soft nature of the ground the holes when fired do not break the ground but simply chamber and blow off a little of the collars.

In drilling up a round in a raise 17 holes are put in, as shown in the accompanying sketch, to a depth of 6 ft. The ground is easily drilled, the machines averaging 14 to 20 ft. per hr. When the round is fired a heading 5x5 ft. is broken with an advance of not less than 5 ft. This is accomplished in an eight-hour shift.

About 92 sticks of 1x8-in. 50% gelatin dynamite are required to a round. Hole No. 2 is loaded with eight sticks of dynamite and fired; this breaks through the other four cut holes Nos. 1, 3, 4 and 5 as shown. Holes Nos. 6, 7, 8 and 9 are then loaded with seven sticks each

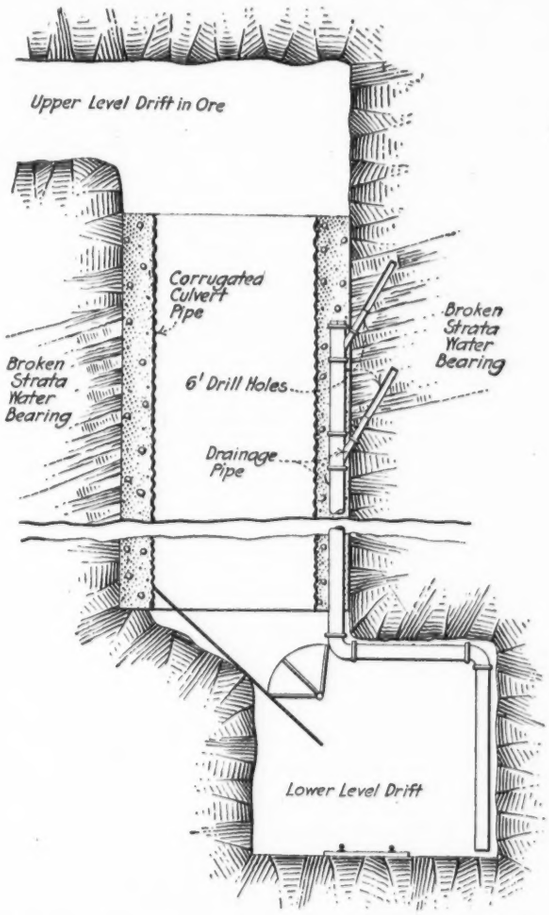
*Mining engineer, Franklin Furnace, N. J.

and fired after the muck is cleaned out of the space made in firing hole No. 2. The remaining eight holes are loaded with seven sticks of dynamite each and fired. At least two bags of tamping is used in each hole and pressed in firmly.

Draining Watercourses in Chutes

By Edward P. Scallon*

In raising, watercourses are frequently encountered. If the raise is to be used as a chute, much delay and annoyance in the subsequent handling of the product are occasioned by an admixture of the water and ore in the chute, and in most cases it is essential that this condition be remedied. At the Lincoln mine of the Inter-State Iron Co., at Virginia, Minn., the form of chute construction shown in the accompanying drawing is employed successfully to overcome the difficulty. After the raise is driven several 6-ft. drill holes are placed in its side, so as to cut the water-bearing strata transversely at different elevations. Pipes are then cemented into the collars of these holes and extended, close to the side of the raise, to the level below. Air lines and any other necessary pipes are placed along the walls, and the entire raise is lined with concrete, corrugated culvert pipe being used as a form.



Type of Chute Construction in Water Courses

All the pipes will of course be embedded in the concrete; the small drainage pipes from the drill holes will now collect all the water and carry it to the level below. This prevents the exertion of any water pressure on the concrete while setting or subsequently, and also allows proceeding with the drainage of the area tributary to the raise.

By the use of these drainage pipes it is found at the Lincoln mine that almost all watercourses can be sealed off with oakum and dry cement. In this case, if desirable, a form of plank chute providing protection to the pipes and cement can be substituted for the more permanent concrete and metal-lined construction described above. The water collected in the pipes from such a raise is used to supply tanks feeding Leyner drills on the lower levels.

*Mining captain, Lincoln mine, Virginia, Minn.

How the Drill Bit Breaks the Rock*

When rock is excavated by a drill bit three applications of forces seem to be involved—by abrasion, by crushing, and by severing or chipping. Although all of these must take place to a certain degree, the greatest amount of useful work is performed when the percentage of force applied to chip reaches a maximum. But in rock it appears that chips can be produced in radically different ways—first, by the severing of molecules, and, second, by the reflex forces produced in an elastic medium. To illustrate this, consider the chipping of a comparatively inelastic substance such as lead. With a hammer and a chisel whose axis is inclined considerably from the normal to the surface of a lead block it is possible to sever the lead and roll up chips, but if the chisel is normal to the surface of a thick block only an indentation can be made and there probably will be a raised area about the indentation to accommodate a certain percentage of the displaced metal. On the other hand, with a highly elastic material such as glass, the forces impressed by a normally positioned chisel will cause a compression of the molecules, whose elasticity will cause their expansion toward a free, unresisted surface. Since the greatest forces are developed at the surface, since the penetration of the chisel carries some forces to a depth below the surface, and since the chisel surface itself applies some forces at an angle to its axis and impedes the reëxpansion of molecules to the space it occupies, therefore, the reflex forces produce more or less cone-shaped chips or flakes and leave a corresponding crater in the block of glass. Now if the chisel is placed near the edge of a block of glass, the blow upon it will induce stresses to another free face and a correspondingly larger chip will be produced because of the tendency of the forces to seek relief in the shortest direction, as well as because of the severing effect. The method of cutting of a drill bit is commonly shown as taking place in this last way with the progressive chipping of a series of benches or steps, but it is doubtful whether such a procedure exists, except in rare instances, for the speed and latitude of rotation between consecutive blows of the drill piston or hammer cannot be controlled with sufficient precision nor adjusted to the various rocks; and

*Excerpt from a paper by Benjamin F. Tillson, "The Testing and Application of Hammer Drills," published in the "Bulletin of the American Institute of Mining Engineers," February, 1915.

an inspection of the cuttings from a drill hole shows them to be flakes or a crushed and abraded powder.

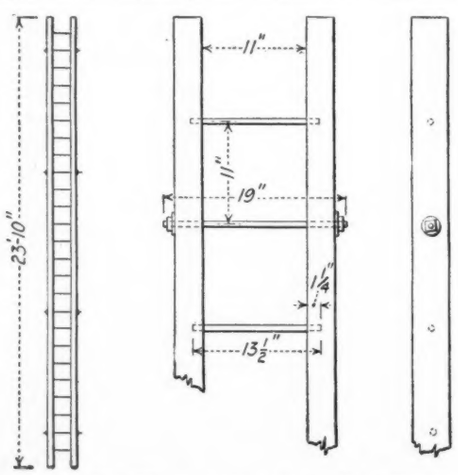
In the formation of these flaky chips there may be a limiting force of blow for each velocity of impression in order to gain the most useful work (i.e., in the production of flakes), for it appears that beyond certain limits the blows increase the percentage of crushed material and the drilling speed does not vary with the force applied, so that some heavy-hitting drills accomplish more in medium-soft ground when a portion of their blows is absorbed by a tappet at the shank end of the steel or by a cushion of water intervening between the bit and the rock. If the force of the blows were decreased by a reduction in air pressure the speed of the piston would be slowed up and the drilling would suffer from the fewer number of blows per minute.

The use of an anvil block is considered by some drill designers to necessitate a loss of from 20 to 30% of the power of a drill, but actual tests do not always indicate such a condition when the identical steel is tested in the same drill with and without a tappet. The results probably depend upon how frequently the tappet is struck when away from the shank of the steel, and also upon the suitability of the machine to the rock; for if its blows are too heavy the intervention of a loose tappet might reduce their force, with a benefit in drilling speed. The use of water at the bottom of the hole ordinarily consumes about 10% of the cutting speed if there is no tendency for the drill bits to lose their temper, and compressed air for cleaning the holes encourages a greater drilling speed, providing the cushion of water in the bottom of the hole does not have a benign influence in reducing too powerful a blow upon the rock.

Steel and Wood Ladder

By Harold A. Linke*

The accompanying illustration shows a substantial and inexpensive mine ladder, the sides of which are constructed of 3x4-in. stuff, S2S1E‡, and the rungs of ½-in. round mild steel. The bill of material is as follows:



Ladder of 3x4-In. Uprights and ½-In. Steel Rungs

Two pieces 3x4-in. by 24-ft. S2S1E.
Thirty feet ½-in. round mild steel, cut into 21 rungs 13½ in. long and four 19-in. lengths, the latter threaded 2 in. both ends.
Eight ½-in. cut washers.
Eight ½-in. square nuts.

After the ladder is made and the bolts tightened it is well to rivet the ends of the tie bolts or burr the exposed threads to prevent the nuts from working off.

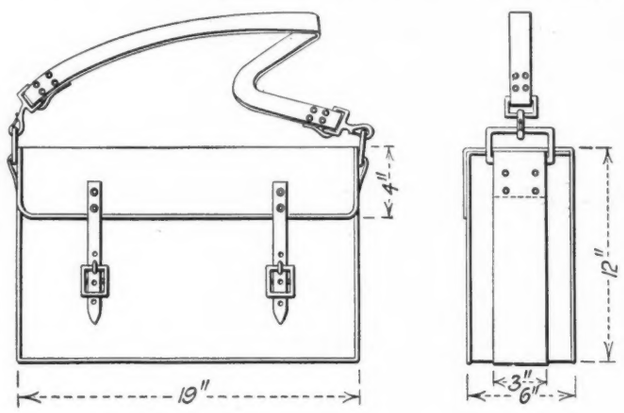
*Mining engineer, 401 Sixth St., Calumet, Mich.
‡Surfaced two sides and one edge.

Bag for Carrying Dynamite

By W. R. Hodge*

A dynamite box in a manway is a stubborn and painful thing to deal with. In the Burra Burra mine of the Tennessee Copper Co. it is often necessary to carry a box of powder up or down 150 ft. of ladders to get it into a back stope. The bag illustrated here has been devised to make easier the transportation of dynamite through the manways.

The bag is of canvas, reinforced by a double strip of the same material on the bottom and ends. At the top of each end the strip is doubled over and riveted about an iron ring to which is snapped the shoulder strap. This strap is of leather 2 in. wide and 3 ft. long, provided with a harness snap at each end. The bag is divided by a canvas partition down the middle, making compartments a little longer than a stick of dynamite. A canvas flap secured by two straps and buckles covers the top of the bag. All seams and edges are leather bound. The capacity of the bag is about one case of dynamite. By its use the hands are left free for the ladders, while (in the stope) the powder is readily accessible for distribution. These bags have been in service about four months, and so far no one has coveted the leather straps—a rather remarkable fact.



Bag for Carrying Dynamite

Block System on Haulageways

In the main underground haulageway maintained by the Bunker Hill & Sullivan mine, through the Kellogg tunnel, two miles long to the shaft, an electric block signal system has been installed and has been in successful operation. This consists of a special circuit of colored lights strung along the tunnel throughout its main haulage length in one-mile sections, operated by the motorman through a lever that can be thrown conveniently at the end of each block. Red lights are used in one direction and green lights in the other, and the motormen are prohibited from entering a block carrying the opposite colored light until it is extinguished and shown to give them a clear track for a mile in length.

*Mining engineer, Ducktown, Tenn.

Details of Milling and Smelting

A Chart for Determining Tailings Value

By W. J. McCauley*

In all cyanide mills it is necessary to know the dissolved value discharged with the tailings. It is convenient to know this in terms of cents per ton of dry pulp.

Many methods are in use for the determination of this value, a common one being to filter a portion of the pulp and assay the filtrate, after which the following formula or a similar one is used:

$$\frac{a\,w}{d\,(1-a)} = W$$

Where

a = Percentage of water in the tailings, expressed as a decimal.

d = Number of assay tons of solution assayed.

w = Weight of gold found in d assay tons (in milligrams).

W = Ounces gold per ton of dry pulp.

This method is not always practical, however, especially on very thick pulps, filter cakes, etc. A method commonly used for such cases is to take a known weight of the wet tailings, to which a known weight or volume of water is added. After thoroughly mixing, the slime is allowed to settle and a known amount of the clear solution is decanted and assayed. The following formula may then be used, in which b is the weight of wet slime taken and c the weight of water added:

$$\frac{(a\,b+c)\,w}{b\,d\,(1-a)} = W$$

The accompanying chart gives a quick and ready solution of this equation. The chart shown is figured for the case where $b = 2000$ grams, $c = 1000$ grams and $d = 30$ assay tons. OA are values of w and OB values of Wv or V—i.e., cents per ton of dry pulp, gold being figured at \$20 per oz. ($v = \$20$).

To use the table follow up the line representing the value of w found by assay until it crosses the diagonal line representing the percentage of moisture found in the original tailings; then go to the left on the horizontal line nearest this intersection, to OB where the value in cents per dry ton of pulp is found.

The chart is constructed as follows: Divide OA, to a convenient scale, into values of w, and OB into values of W or V as desired. Select two points C and D, one on OB and one on OA, such that they represent the same value, one in ounces per ton of dry pulp and the other in ounces per ton of solution—i.e., $\frac{V}{v}$ and $\frac{w}{d}$. Draw the line CD and divide it into two parts, DE and EC, such that $DE : EC :: c : b$, and through the point of division E draw the line 00. This is the line of 0% water.

Now divide EC into 100 equal parts and through each point of division draw lines to 0, producing them to the limits of the drawing. These lines represent all values from 0% to 100% of water.

If the assay is conducted according to the first method mentioned, where the wet tailings sample is filtered and

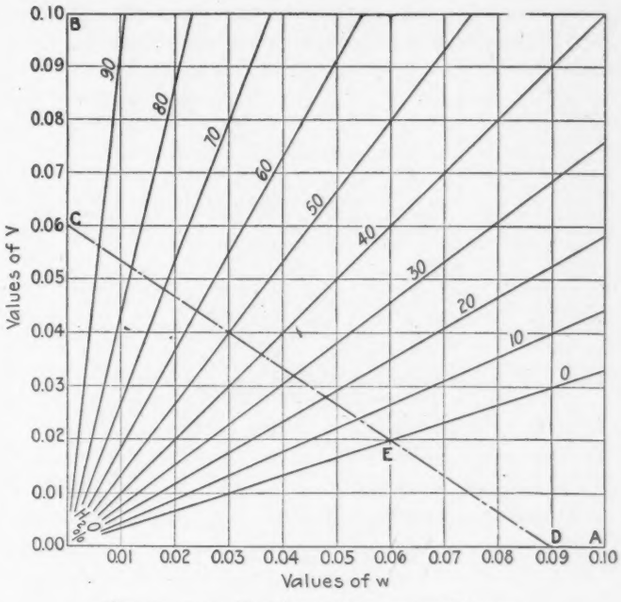


Chart for Finding Tailings Value

the filtrate assayed, c and b drop out and the formula becomes:

$$\frac{a\,w}{d\,(1-a)} = W$$

In this case the line 00 coincides with OA and the chart is much more easy of construction. This general form of chart may be used for the determination of cyanide in pounds per ton of dry pulp, and is useful in many other pulp problems.

*Assayer, Mogul Mining Co., Terry, S. D.

Considerations Which Govern Leaching-Plant Operation*

These experiments were made on about 300 tons of oxidized ore shipped from the various shafts and test pits and during the development of the property.

The ore was charged dry into the vats. The lixiviants were admitted on top of the ore but at one side of the vat, and no faster than could be absorbed by the charge. By making a little dam on top of the charge, the lixiviant passed immediately to the bottom of the vat and saturated the charge from below, thus permitting the escape of air and gas.

The soluble copper in the tailing was determined by boiling the laboratory sample (100 mesh) in 10% sulphuric acid. The copper not soluble by this treatment

*Excerpt from a paper by Stuart Croasdale, read before the Utah meeting of the A. I. M. E.

must exist as sulphide or as other minerals in the ore, not capable of being extracted by sulphuric acid and therefore is not available by this metallurgical process.

Lot 3 was crushed to ½-in. mesh.

Lot 4 under similar conditions was crushed almost to ¼-in. mesh, as shown by the following screen analyses:

Mesh	Lot 3 Per cent.	Lot 4 Per cent.
—2 + 4	16	6
—4 + 8	27	27
—8 + 16	17	21
—16 and finer	40	46

	Dry Wt. Lb.	Cu %	Cu Sol.	SiO_2 %	Fe %	Al_2O_3 %	CaO Sol.	S total	S sulphate
Lot 3	111,230	1.48	1.32	64.00	4.20	14.30	0.45	0.20	0.04
Lot 4	89,670	1.44	1.30	63.30	4.20	15.10	0.60	0.20	0.06

The results from these tests are shown on the following table:

	Test 1	Test 2
Pounds ore leached	90,533	80,458
Per cent. copper	1.44	1.43
Average hours acid leaching	70	100
Average hours washing	7.0	23.0
Final tailing, per cent. total copper	0.27	0.40
Final tailing, per cent. soluble copper	0.23	0.38
Pounds copper extracted per ton of ore	23.3	20.6
Percentage of copper extracted	81.2	71.8
Total per cent. of material extracted from ore	3.0	3.0
Actual percentage of copper extracted	81.8	72.7
Percentage of available copper extracted	83.5	73.0
Gallons lixiviant used per ton of ore	123	137
Average per cent. acid in lixiviant	9.5	7.0
Pounds acid consumed per pound copper dissolved	3.5	3.3
Gallons wash water used per ton of ore	135	177
Rate of percolation in inches per hour, measured in inches of solution above the ore in vat	43.0	11.0
Average value of nearly neutralized lixivium sent to precipitating vats:		
Copper, per cent.	2.41	2.90
Iron, per cent.	0.56	0.70
Alumina, per cent.	0.53	0.73

These results show clearly the effect of finer crushing on the same grade and character of ore. Both of these lots were substantially the same character of ore in every respect. They were much altered by oxidation and contained practically no insoluble copper in the tailings, although the ore itself showed 0.08 to 0.10%, probably as cuprite, which dissolved in the ferric salts extracted from the ore.

The extraction on the four-mesh material was 9.4% lower, and the rate of percolation dropped to one-quarter of that on the two-mesh material. Hence much more time was consumed in leaching and washing the ore, with poorer results.

The difficulty in extracting this copper led to a more detailed analysis of the tailings to determine whether the copper was retained by the coarse material alone or whether the colloidal slime also had a tendency to absorb and retain copper even after it had gone into solution. The latter was found to be the case.

These results are interesting, since they show that the colloidal slime absorbs, or retains mechanically, as much copper as is held by the coarse material. As anticipated, there is also an increase in the percentage of alumina in the fine material.

This retention of the copper by the slime was also noticeable in washing the ore. Although the charges in Lot 4, Test 3, were washed a much longer time and with 50% more water than those in the previous tests, the analyses of the wash waters showed a very slow removal of the copper. Where the percolation was slow and the tailings high, even the sixth volume of wash water contained a high percentage of copper, while the acid was removed as readily as in previous tests. This confirms the well known properties of colloidal or argillaceous material for retaining mineral salts. In this test, partly neutralized lixiviants were used on new ore in every charge, which could not always be done in the other tests. This had a tendency to lessen the consumption of acid, and neutral or nearly neutral solutions could be sent to the precipitating tanks. As stated before, if the acid contents of these lixiviants are too low and they become completey neutralized, part of the copper is reprecipitated in the ore. It would therefore be advisable to send the lixivium to the precipitating tanks slightly acid. Lixiviums containing relatively high percentages of ferric sulphate, and perhaps aluminum sulphate in the form of alum, show an acid reaction that corresponds to 0.2% to 0.5% of sulphuric acid.

Other similar tests were run, varying conditions somewhat, of which we abstract only the conclusions or the important features.

In treating different grades of similar ore, the value of the tailings is practically a constant. Consequently, with two ores of 2% and 1%, respectively, recovery on a percentage basis will usually be much lower on the lower-grade ore.

Several charges of the leached ore were washed with as much as 1500 gal. of water per ton, or until the final wash water showed no copper or acid. This extra and complete washing had absolutely no effect on the soluble copper in the tailings, which remained as high as in charges washed with one-tenth of the water.

This fact points to the importance of studying carefully the gangue of an ore, even if it may not be acid consuming. The ability of argillaceous and some colloidal material to absorb and retain mineral salts is well known, and these experiments have shown it to be quite a factor in leaching raw oxidized porphyry ores with sulphuric acid.

It was found inadvisable to saturate the ore with water before applying the first lixiviant. This water must, of course, be replaced by the acid before the copper can be dissolved, and the interchange takes place but slowly through the pores of the ore. The acid lixiviants should be applied to the dry ore.

There was usually very little increase and sometimes a considerable decrease in the copper contents of the first lixiviant if the free acid and ferric sulphate in solution were not sufficient to destroy the alkalinity of the ore. Therefore it is a waste of time and expense to use lixiviants too weak to accomplish this purpose.

Cactus as a Binder

The U. S. Patent Office has recently granted a patent to F. Meyer, of Denver, Colo., on a new binder for briquetting coal dust, coke breeze, flue dust and fine ores.

The new binder is the liquid extract of cactus, and its wide occurrence in all the southwestern states and its almost absolute uselessness for other purposes ought, according to the patentee, to furnish a binder cheaper than any other mentioned in the various publications of the Bureau of Mines on the subject of briquetting of fuel.

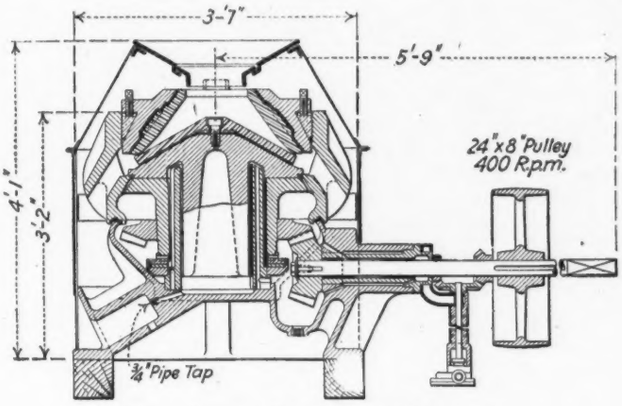
There can be no doubt that cactus has excellent binding qualities. Any one who has ever had the misfortune to experiment with cactus knows that its pulp is as sticky as glue, and we also know that the extract of *Cactus opuntia* is often used as a substitute for tragacanth by confectioners.

Mining & Metallurgical Machinery

Smith Crushing Machine

A new applicant for honors in the ore-crushing field is the Intercone machine, shown in the accompanying illustration. It is probably applicable, in mining work, to operate between the coarse breakers and the machines which make a 20-mesh or finer product.

The feed is vertical, lessening the probability of bridging, and crushing is performed between the mantle head and the hollow cone, both of which revolve in the same direction and at the same speed, but upon slightly different centers. The discharge is assisted by centrifugal force, which tends to avoid clogging, and the machine



THE SMITH INTERCONE CRUSHER

may be driven in either direction. It is said to be compact, may be placed in any position and the crushing motion is horizontal. It is made by the T. L. Smith Co., of Milwaukee, Wis.

The Largest Rock Breaker

The Traylor Engineering & Manufacturing Co. is now building for the Rockland Lake Trap Rock Co. a crusher with jaw opening 66x86 in., which will be used for crushing the hardest known trap rock. The machine will be installed just outside of New York City and will weigh over 520,000 lb. The notable feature in its manufacture is that practically the whole machine is constructed of cast steel, thoroughly annealed, to eliminate internal strains.

The machine is approximately 26 ft. long, 18 ft. high and 20 ft. wide; the crushing plates are made of manganese steel, as are also the cheek plates and toggle seats, giving these wearing parts the longest possible life. The pitman is of cast steel, of the box-section type, and fitted with internal ribs and a removable cap to facilitate handling. The pitman is also fitted with removable bushings, babbitted and water-cooled. The installation of bushings in this part greatly facilitates the rebabbitting of the eccentric or pitman whenever necessary and eliminates the necessity of shutting down the crusher for two or three days, which would be the case if the babbitt were poured in place in the pitman.

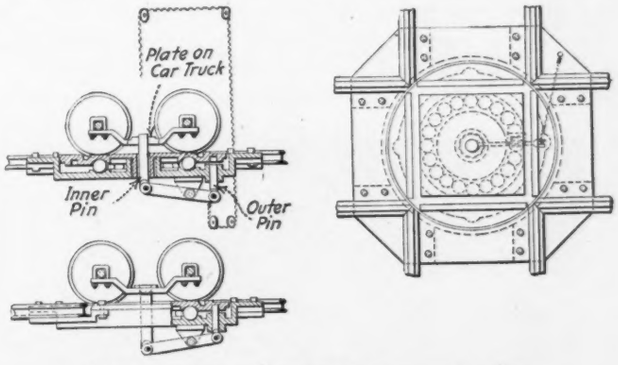
The bearings on the side frame are fitted with removable bushings, water-cooled and babbitted, allowing quick rebabbitting. Under normal operating conditions, however, the babbitt should not be touched in a whole year's operation; in fact, in the large crushers which are running the babbitt is not touched except when the plant is shut down for two weeks in the winter time for over-hauling. It is not necessary, however, to do this, as it has been found at the end of the year that the babbitt was in as good condition as when the crusher started.

The water-cooling features on these large crushers make it possible to run the crushers continuously without heating, and the lubricating expense is greatly reduced, for the reason that only about one-third of the lubricant necessary under ordinary conditions is used with water-cooled bearings. The water-cooling device has worked so satisfactorily that the Traylor company has adopted the design for all of its jaw crushers.

The Rockland Lake crusher will have a capacity of 400 tons per hour, crushing down to about 10 in., and will use from 180 to 240 hp. The estimated power is based on operating conditions of other large crushers in use.

Ball-Bearing Turntable with Latch

The Simmonds Engineering Co., of Iola, Kan., has recently put on the market a new type of turntable for small vehicles, such as mine cars. The turntable is of the ball-



BALL-BEARING TURNTABLE WITH LATCH

bearing type and has a novel feature in the form of a latch which locks it in position so that its tracks register with the tracks leading up to it. The operation of this old latch is shown in the illustration. It consists of two pins on opposite ends of a lever set underneath the turntable and attached to the fixed portion of the apparatus. The larger of these pins operates vertically through the center of the turntable and is engaged by a hole in a plate carried by the mine car itself. The other pin slides vertically near the outside of the turntable and engages a hole in the upper rotating part of the apparatus when the

table is in any one of its several registering positions. The inside pin is heavier and keeps the latch always in operation unless it is released by some means.

Suppose the turntable locked and a car about to be run on it. When the car is centered, the operator by some suitable mechanism depresses the small outer pin and by this means thrusts up the large inner pin so that it enters the hole in the plate under the car. If the turntable is now swung slightly, the outside pin is brought out of register with the hole in the upper plate of the turntable and is thus kept depressed, at the same time keeping the inner pin lifted. The inner pin then serves to hold the car in place on the platform. When the turntable is swung so that the tracks are again in alignment as desired, the weight of the inner pin depresses it and forces the outer pin up, since it now registers with another hole. The car is then released and can be pushed off the turntable.

Some Useful Adjuncts to Mining

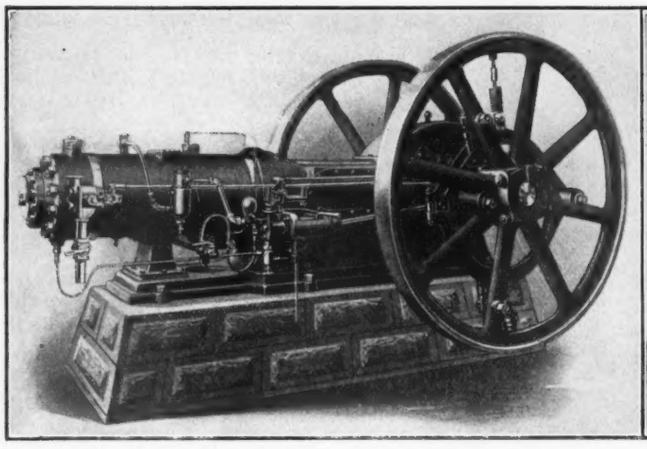


FIG. 1.

FIG. 2.

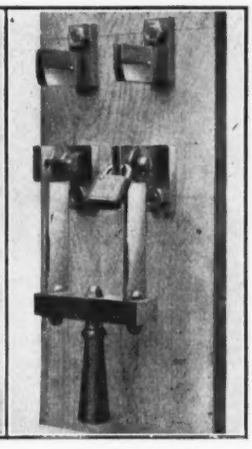
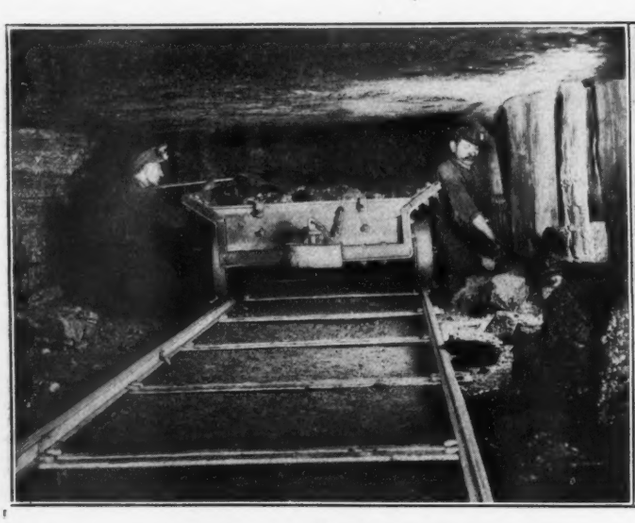


FIG. 3.

Fig. 1. The Bessemer Oil Engine—A two-cycle engine with driving parts fully inclosed and running in an oil bath. The scavenging air does not pass through the crank case, but is taken directly into the crank end of the cylinder. There are no valves, the fuel being injected at the end of the compression. The engine is manufactured by the Bessemer Gas Engine Co., Grove City, Penn.

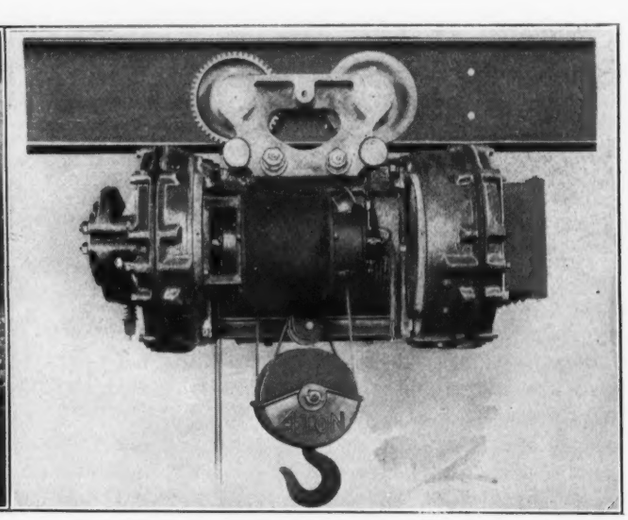
Fig. 2. A Powerful Electromagnet for Hospital Use—The Westinghouse Electric & Manufacturing Co. has just installed this extremely powerful electromagnet in its relief department at East Pittsburgh for extracting splinters of steel from workmen injured by flying fragments. It is similar to that used by the allied armies for extracting pieces of shrapnel shell.

Fig. 3. A Safety Knife Switch—The hinge clips of the switch extend beyond the blade and the switch can be locked against closure by means of a padlock, to which only the man working on the line has a key. This is manufactured by the Cutler-Hammer Manufacturing Co., of Milwaukee.



THE SLICK MINE TIE

From a photograph taken in a Pennsylvania coal mine showing the Cambria Steel Co.'s Slick mine tie. The use of this tie gives about 3 in. more room between car top and roof, thus facilitating loading.



LINK-BELT TROLLEY HOIST

A new type of hoist manufactured by the Link-Belt Co., of Chicago. The hoist has a dynamic-braking system, the descending load driving the motor as a generator. Very litle headroom is required by this hoist.

Correspondence and Discussion

Failure of Hollow Drill-Steel

From time to time there have appeared in the technical press articles relating to the failure of hollow drill-steel. The cause has been attributed to many different reasons, principal among which were too rapid a movement of the hammer, a flaw or node in the steel and the development of the hammer machine beyond that of the steel. As one who has had a wide experience in the field as well as in the manufacture of hammer drills, I wish to present some observations of my own which may be interesting.

The McKiernan-Terry Drill Co., with which I am associated, has been a manufacturer of hammer drills since 1904 and has used hollow steel since 1905, when it was first offered to the trade in this country. Since then, and until now, I do not recall a complaint from a customer with regard to the breakage of steel, and have not had occasion to complain to the manufacturers of the steel, except as to its carbon content. With our drills I have found that the steel giving the best service should not be larger than 1-in. hexagon with a $\frac{3}{16}$-in. hole, although the standard size we use is $\frac{7}{8}$-in. quarter-octagon with a $\frac{3}{16}$-in. hole. We have used, too, with good results $\frac{7}{8}$-in. hexagon and drilled holes with it to a depth of 12 ft., finished to $1\frac{1}{4}$-in. diameter. In one case with $\frac{7}{8}$-in. hexagon hollow steel I recall that there was but one drill steel broken in a two weeks' run. Occasionally there will be failures of hollow steel, but not more than would be looked for or expected with a 3-in. or $3\frac{1}{4}$-in. piston machine drilling holes to the same depth and using $1\frac{1}{8}$-in. or $1\frac{1}{4}$-in. solid steel.

The reason we have had no complaints of hollow-steel breakage with our hammer drills is no doubt due to the fact that the valve motion of our drill is such that the hammer acts as a solid mass with the steel in cutting the rock. In addition to this, in our rotating hammer drills, the impact of the hammer on the shank takes place when there is no torsional strain upon the steel. Failure of the steel will generally be found when the stress of impact takes place during the stress of rotation. These stresses occurring simultaneously cause a compound strain in the steel, resulting in its failure far below the breaking point for either stress applied separately.

When examined broken steel often shows an oxidized spot. Many of these are of crescent form with the points of the crescent converging at the central hole through the drill steel. These spots or oxidized surfaces are by some considered to be the indication of an original fault in the steel, but a close inspection shows a shading of the oxidized surfaces, and at times two or more crescents will be visible. In my opinion, this would indicate that the fracture has occurred in successive stages until the steel has become so weakened that a break occurs, and this will show a bright surface. The appearance of the oxidized spot does not necessarily indicate that there was a flaw in the steel, but rather that it was caused by an undue strain which developed the fracture. I am also led to believe that such steel is of good quality, for if it were otherwise it would have been completely severed at the first fracture. The position of the fracture may be the result of striation in the hole of the hollow steel as suggested by E. G. Spilsbury.

These observations have no reference to failures that occur at the bit or near it, since breakage of this character is largely due to the workmanship and heat treatment of the steel.

It is most desirable that the hammer-drill manufacturer be able to procure the best steel that can be produced, and in order that the steel maker may be able to meet our demands he should have as complete data on the subject as it is possible for us to give him. Hammer-drill users are also interested in the matter, and it would seem that any views along the line mentioned would be of much assistance to the manufacturer of hollow steel who is desirous of improving the quality of his product.

New York, Feb. 11. T. E. STURTEVANT.

Metallurgical Residues as Insecticides

The note on the use of zinc-retort residues for prevention of hog cholera in the JOURNAL of Feb. 13, 1915, reminds me that many years ago at an iron furnace in the South there was a little zinc in the ore; the zinc oxide (or perhaps blue powder, as it was blue in color) became concentrated at certain points in the gas mains and constituted a considerable precentage of the flue dust at those points. This material was found by the local gardeners to be an absolute "specific" for the Colorado beetle or potato bug and became extensively used locally for the purpose. A small quantity of the dry dust was sprinkled in the vines and the bugs quickly died. The discovery damaged the local market for paris green, but did not help the iron company for the quantity used was inappreciable in comparison with that produced. It would seem as though zinc must have some insecticide property not fully understood, at least among metallurgists.

New York, Feb. 13, 1915. SUBSCRIBER.

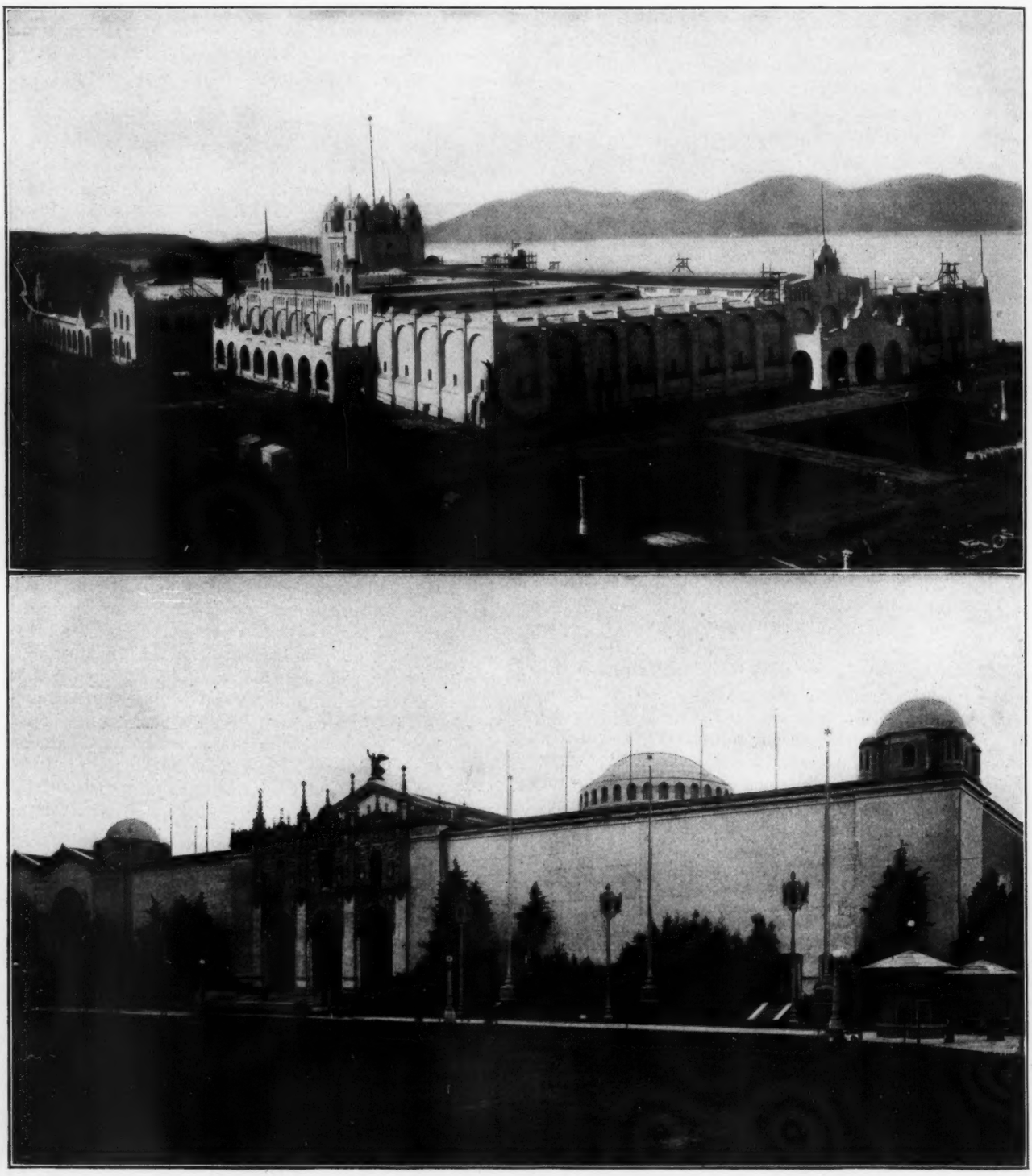
First-Aid Teams

Misther Editor:

I have bin an enthussyastic supporther av th' safety-first movemint, but I have had an unplisant ixpirience on me subway job, which makes me fale a thrifle doubtful. We have had a foine riscue team. Given a practice run on a wop who has bruk his arrum and sprained the medallion obbligato (as the docthor boy puts it) we cud carry off ivery prize. And yet, th' other day, whin I had a rale cave-in an' we dug th' man out, the team fixed him up for a confound fracshun of the femure (docthor boy agin) an' whin the rale docthor came he says, "Begorra, it's an illigant job you did, but his ribs is bruk." An' his woife busted up the group wid a rollin' pin and said it was a limmon-aid team. Now, pwhat does a first-aid team do whin nobody tells thim in advance pwhat is wrong wid their victim?

Brooklyn, Mar. 18, 1915. BILL MCGINTY.

Photographs from the Field



AT THE PANAMA-PACIFIC EXPOSITION

The California State Building, presenting a general idea of the situation. The Mines and Metallurgy Building, the focus of professional interest at the present time

MINING METHODS IN THE YUKON

Hydraulic mining at Dawson. Driving steam points for thawing ahead of the dredge, near Dawson

American Smelting & Refining Co.

SYNOPSIS—Abstract of the annual report of the American Smelting & Refining Co. The report is much more complete than those of previous years, and shows amounts received from the sale of each separate metal, separate mining and smelting profits, etc.

The total earnings of the company in 1914, after deducting all expenses, fixed charges and a proper allowance for the Federal income tax payable on 1914 earnings, aggregated $10,811,915. From this amount was deducted for depreciation $1,540,350, and for losses incident to the Mexican and European wars, $240,000, leaving $9,031,565 net earnings applicable to dividends. After paying the dividends the sum of $1,014,115 was carried to profit and loss account.

The combined profit and loss account of the company and its subsidiaries since its organization in 1899 shows: Net gain after paying fixed charges, $144,702,115; depreciation, $20,869,888; dividends paid, $104,322,169; surplus, $19,510,058.

The total net gain for 1914 was but $710,143 less than in 1913, which again illustrates the regularity of the earning power of this company. When the internal national difficulties began in Mexico the directors declared to the stockholders that the operation of the company's properties outside of Mexico had an earning capacity more than equal to the dividend requirements. Large expenditures, extending over many years, on the plants of the company in the United States and in the purchase of new properties have increased the operating capacity and have reduced the cost of smelting and refining. So long as conditions remained normal these improvements continued to show their effect in increased net earnings in all directions except in Mexico, but the war in Europe brought about, temporarily, an absolute cessation of buying in virtually all of the metal markets of the world. After Aug. 1 and up to the end of 1914 the company suffered from a large reduction in the output of the principal lead and copper producing mines, but since the opening of 1915 the demand has shown such satisfactory improvement that these principal mines are now increasing their output.

The condition of affairs in Mexico continues to cause the directors anxiety. About Aug. 1 it seemed that most of the company's plants and mines in Mexico would soon be able to resume operations, at least to a limited extent. The resumption of operations, however, proved to be only temporary.

During 1914 the property at all the plants and mines was kept in good physical condition by the expenditure of $1,879,125, which has been charged in the regular operating expense accounts. In addition, there was expended for improved facilities and new properties $1,275,772, which was charged to the property account. This account has also been credited with a depreciation charge of $1,540,350, so that the property account shows a decrease from the report of last year of $264,578.

On account of the reduced ore receipts, the several plants were able to work up many accumulations of ores and furnace byproducts. At the end of 1914 the total value of metals on hand, in process of treatment or refined and ready for the market, aggregated $24,660,942, a decrease during the year of $1,820,060. The ore on hand produced from mines belonging to the company is valued in the inventory at its cost of production. All other metals on hand are valued at the same quotations as have been used for several years.

During 1914 there was added to the cash working capital of the company the sum of $904,343, derived as follows: From net earnings (before deducting depreciation to property) less fixed charges and dividends, $2,554,465; less amount expended on the property of the company, for investments and for bonds and stocks purchased for retirement, $1,650,122; net increase in working capital, $904,343. Metal stocks and other net current assets were converted into cash to the amount of $3,086,769; so that at the end of 1914 the total cash on hand and subject to check was increased to $8,034,778.

The strong position of the company as to cash on hand at the beginning of the European war, when for a time there were no quotations for silver, lead or copper, permitted the management to advance cash against ore shipments of the mines, although for a considerable period of time the products could not be sold, nor was there a basis upon which to fix the value of the ore. The directors believe that the various miners whose product is under contract to the company were eminently pleased and satisfied with the accommodation given them.

Volume of Business

The following condensed statement of the cash receipts of the company for 1914, together with the application thereof, and a few operating statistics will give the stockholders some conception of the extent of the company's operations:

Cash Receipts—		
Cash on hand and in bank subject to check on January 1, 1914		$4,043,666.41
From sales of metals*		
Gold	$52,094,016.24	
Silver	41,209,569.90	
Lead	23,125,635.89	
Copper	61,619,487.35	
Other metals	2,431,409.82	
Total	$180,480,119.20	
From mining properties	3,135,809.21	
From manufactured products	2,665,957.61	
From miscellaneous income, rents, interest, commissions, etc.	1,223,514.39	
Total from sales and miscellaneous income	$187,504,400.41	
From quick assets of Jan. 1, 1915, demand loans and foreign bills of exchange	1,991,622.21	
Accounts collectible	993,829.14	
Total cash receipts		190,489,851.76
Total cash to be accounted for		$194,533,518.17
Cash payments—		
For ore and bullion purchased and administration expenses and taxes	$173,864,673.45	
For expenditure on property	1,275,772.01	
For miscellaneous investments	20,850.00	
For interest on bonds	808,064.46	
For dividends to stockholders	8,017,450.00	
For company's debenture bonds purchased	183,500.00	
For company's preferred "A" stock purchased	170,000.00	
For advances to affiliated companies	101,802.49	
For transfer to special funds	115,063.90	
For reduction of current liabilities, etc.	1,941,563.73	
		186,498,740.05
Balance cash on hand and in bank subject to check Dec. 31, 1914		$8,034,778.12

*Does not include value of toll metals not delivered for cash aggregating $6,253,643.95.

A. S. & R. METAL PRODUCTION

	Value
Metal produced—	
Gold	$52,515,548.55
Silver	42,690,226.10
Lead	24,551,632.05
Copper	71,712,527.40
Other metals	2,431,409.82
Value of products of mines	3,135,809.21
Value of manufactured products	2,665,957.61
Miscellaneous income	1,222,514.39
Total volume of year's business	$200,925,625.13
Net earnings available for dividends	$9,031,565.10
Per cent. of net earnings to volume of business, 4.49+.	
Employees—	
Total number of men employed (excluding Mexico)	12,179
Total wages and salaries paid (excluding Mexico)	$10,212,591.40
Average wages per employee per 8-hr. day	$2.33
Tons of ore mined	1,266,702
Tons of coal mined	257,942
Tons of charge smelted	4,171,258
Tons of bullion refined	588,718
Tons of coke produced	129,650
Tons of coal used	544,619
Tons of coke used	447,761
Barrels of oil used	976,528
Cubic feet of gas used	7,430,300
Ounces of gold refined	2,540,911
Ounces of silver refined	77,604,483
Tons of lead refined	316,591
Pounds of copper refined	529,686,000
Pounds of metal products manufactured	40,122,817

Many years ago the company decided that it was advantageous to introduce, in connection with all 24-hr. work, the three-shift system, giving to all men eight hours' work, instead of 10 and 12, as had previously been the custom. At the present time less than 6% of its labor works 12 hr. daily, and even this unimportant proportion is being eliminated. There is no doubt as to the desirability of instituting 8-hr. labor in place of longer hours for the health and welfare of the men. In most cases the company had been obliged to pay the same wages for 8 hr. work as it had previously paid for 12 hr., and the company has sought to offset the increase in the cost of operation by labor-saving devices. The two changes have gone hand in hand, so that the company is not able to decide as to the comparative efficiency of men working a shorter number of hours. The capital expenditure, however, in connection with these labor-saving devices has been large, but undoubtedly it has been a profitable investment. In one of the works where these devices have been installed to the greatest possible extent the same amount of work is done with one-third the number of men as in another plant doing the same class and amount of work but where labor-saving devices have been introduced only to a limited extent.

In conclusion, Daniel Guggenheim, the president, says:

"At the request of the U. S. Commission of Industrial Relations your president recently appeared before that body and testified fully as to the conduct of the operations of your company and as to its relations with its employees.

"The stockholders may rest assured that the directors of the company are fully alive to all subjects of public and corporate welfare touched upon in these investigations, and since nearly all of them are officers of the company in charge of its various operations, they are brought into daily contact with all these matters.

"Careful consideration has been given to the subject of unreasonable profits, unduly long hours of labor, the payment of less than living wages, and unfair methods of competition as affecting the prices of either raw or finished products.

"The company purposely keeps its treatment charges as low as possible, in order to encourage the maximum production of ore, and it endeavors to make sales of its metals at the same prices at which they were purchased, and therefore it is not financially interested in the market price of its products. Your company pays cash for the metal oftentimes of hardly appreciable quantities per ton of ore. This all must suffer more or less loss and great risk in each of the many metallurgical processes through which it passes, and on the average the resulting fine metal is not converted into cash in less than four months after the purchase. The buying, smelting, transporting, refining and selling, with all of the innumerable risks, of the vast sum of two hundred millions of value is, as already stated, effected for a profit of less than 4½% of the annual turnover.

"Even these profits, however, cannot be obtained from smelting and refining alone, but are secured through the ownership of producing mines, the production of coal and coke, the manufacture of many metal products, the production of sulphuric acid from formerly wasted fumes and the saving of various products from the dust of flue chambers of too infinitesimal quantities to be discovered in the original ore, all of which is obtained through the expenditure of large amounts of capital and the command of the best metallurgical talent."

Bauxite Deposits in Dutch Guiana

By F. B. Percival*

Dutch Guiana is on the lookout for capital to operate some extensive bauxite deposits recently discovered on the Saramacca River.

Bauxite, which is hydrated aluminum oxide mixed with certain impurities, such as silica, iron oxide, titanic acid and carbonate of lime, occurs in numerous varieties even within limited areas. The two principal varieties in

Bauxite Deposit on the Saramacca River, Dutch Guiana

Dutch Guiana are red and white. The red is rather compact and of a granular nature. The white bauxite is very siliceous and is found in compact masses which break away easily.

The discovery was made in September, 1914, by Mr. Pay, an engineer. He found the mineral in a chain of hills bordering the Saramacca River. The deposit is easily operated, since the transportation of the mineral is facilitated by the passage of vessels of light draft. The mineral can be loaded into the ship's hold alongside the bank of the river. The analysis of the material shows a large percentage of aluminum.

*Paramaribo, Dutch Guiana.

The United States Steel Corporation in 1914

The report of the United States Steel Corporation covering 1914 gives the usual full statement of the financial and other transactions for the year. Limited space compels us to present most of the details in tabular form. The first table is a condensed statement of the general balance sheet as of Dec. 31, 1914.

CAPITAL ACCOUNT

Common stock	$508,302,500
Preferred stock	360,281,100
Subsidiary Co. stocks	589,043
Bonded debt	627,045,112
Notes for future mining royalties	26,976,001
Mortgages, etc.	6,492,218
Current liabilities	41,867,829
Reserve funds	30,475,218
Surplus appropriated to capital accounts	55,000,000
Undivided surplus	135,204,472
Total liabilities	$1,792,233,493
Property accounts	$1,457,853,930
Mining royalties advanced, etc.	44,242,832
Deferred charges	1,784,936
Sundry investments	3,477,257
Sinking and reserve fund assets	15,804,960
Inventories, material on hand	158,091,036
Cash, current accounts, etc.	110,978,542
Total assets	$1,792,233,493

During the year bonds of subsidiary companies were issued to the amount of $9,407,000, while bonds were paid off or were redeemed by the various sinking funds to a total amount of $9,535,264, making a net decrease of $128,264 in the funded debt.

The expenditures during the year for additional property, new plants and other permanent improvements were $23,171,013, two of the larger items being $4,649,196 for the new steel plant at Duluth and $2,046,176 for steamships for export trade.

The second table shows the gross receipts and the income account for the year. As compared with 1913,

EARNINGS AND INCOME

Gross earnings:	1913	1914
To customers outside of U. S. Steel	$518,999,605	$380,228,143
Intercompany sales	211,910,441	129,565,729
Transportation companies	57,726,430	42,040,131
Miscellaneous	8,257,823	6,580,930
Total	$796,894,299	$558,414,933
Manufacturing and operating costs		494,824,859
Net balance		$63,590,074
Subsidiaries' accounts, investments, etc		18,156,444
Total net earnings		$81,746,518
Subsidiary charges		$10,082,903
Depreciation and replacement funds		17,044,183
Sinking funds		8,099,024
Interest on U. S. Steel bonds		23,148,618
Total charges		$58,374,728
Surplus		$23,371,790
Add adjustment of accounts, etc.		124,978
Total surplus for 1914		$23,496,768

there was a decrease of $238,479,366 in the gross receipts and a decrease of $65,517,630 in net earnings. Payments from surplus were $25,219,677 for dividends of 7% on preferred stock and $15,249,075 for dividends of 3% on common stock, leaving a deficit of $16,971,984 for the year. The common stock dividends include two of 1¼% each and one of ½%, no dividend being declared for the fourth quarter.

SHIPMENTS OF MATERIAL

(In Tons)

	Domestic	Export	Total
Rolled steel and finished products	7,982,325	1,096,234	9,078,559
Pig iron, ferro, ingots, scrap	494,144	47,790	541,934
Iron ore, coal and coke	1,153,575	.....	1,153,575
Sundry materials and byproducts	80,357	190	80,547
Total	9,710,401	1,144,214	10,854,615
Universal portland cement, bbl.	9,117,752	.....	9,117,752
Total value of business	$337,444,052	$42,784,091	$380,228,143

The aggregate amount charged to gross earnings for depreciation of plants and exhaustion of minerals from lands owned was $64,847,641 during the year.

The third table shows the total production of all mines and plants for the year. The raw materials—ore, coal, etc.—are used in the manufacture of the finished products shown in the table.

GENERAL STATEMENT OF PRODUCTION

Products	1913	1914
Iron Ore Mined		
In the Lake Superior Ore Region	Tons	Tons
Mesabi Range	21,634,206	10,894,463
Vermilion Range	1,301,163	1,112,854
Gogebic Range	1,871,700	1,469,601
Menominee Range	980,346	874,909
Marquette Range	583,266	496,896
In the Southern Ore Region		
Tennessee Coal, Iron & R.R. Co.'s Mines	2,367,770	2,186,258
Total	28,738,451	17,034,981
Limestone Quarried	6,338,509	4,676,479
Coal Mined		
For use in the manufacture of coke	24,081,192	15,890,382
For steam, gas and all other purposes	6,705,381	5,271,911
Total	30,786,573	21,162,293
Coke Manufactured		
In beehive ovens	11,062,138	7,092,792
In byproduct ovens	5,601,342	4,081,122
Total	16,663,480	11,173,914
Blast Furnace Production		
Pig iron	13,879,706	9,909,062
Spiegel	65,236	25,397
Ferromanganese and silicon	135,788	117,998
Total	14,080,730	10,052,457
Steel Ingot Production		
Bessemer ingots	6,131,809	4,151,510
Openhearth ingots	10,524,552	7,674,966
Total	16,656,361	11,826,476
Rolled and Other Finished Steel Products for Sale		
Steel rails (heavy and light tee and girder)	1,927,745	978,907
Blooms, billets, slabs, sheet and tin plate bars	842,175	921,826
Plates	1,108,147	689,241
Heavy structural shapes	998,624	613,739
Merchant steel, bars, hoops, bands, skelp, etc.	2,024,192	1,423,740
Tubing and pipe	1,186,740	818,435
Wire rods	174,478	164,153
Wire and products of wire	1,432,182	1,380,376
Sheets (black and galvanized) and tin plate	1,280,537	1,075,419
Finished structural work	652,363	521,225
Angle splice bars and all other rail joints	256,676	129,849
Spikes, bolts, nuts and rivets	86,465	62,133
Axles	159,075	64,662
Steel car wheels	93,375	53,638
Sundry steel and iron products	152,064	117,169
Total	12,374,838	9,014,512
Spelter	30,424	28,031
Sulphate of iron	33,829	30,212
Universal portland cement, bbl.	11,197,000	9,116,000

No figures of cost of production are given in the report. Only a very rough approximation can be made. The gross receipts were $61.46 per ton of rolled and finished steel, or $51.48 per ton of all material shipped, excluding portland cement; the net earnings were $9 and $7.53 per ton respectively. Taking another statement, the value of all materials shipped, again excepting cement, was $41.88 per ton.

The fourth table shows the total shipments of products of all kinds to purchasers, the domestic and foreign business being given separately. The decrease in total tons shipped was 25.4%; in total value of shipments, 26.7%. The decrease in value of export business was 36.9%; in domestic business, 25.2%. The value of the export trade was 11.25% of the total sales.

The average number of employees in the service of all companies was as follows:

	1913	1914
Manufacturing properties	165,277	131,616
Coal and coke properties	24,996	16,155
Iron ore properties	13,789	11,170
Transportation lines	21,951	17,857
Miscellaneous	2,893	2,555
Total number	228,906	179,353
Total salaries and wages	$207,206,176	$162,379,907

The decrease in the number of men in 1914, as compared with 1913, was 49,553, or 21.6%. The average wage

or salary per day in 1914, excluding general administrative and selling force, was $2.88; including all employees, $2.97, against $2.85 and $2.92 respectively in 1913. The total amount paid for wages in 1914 was 29.1% of the gross receipts.

Gold Production of Australia

The corrected gold production of Australia, as shown by the reports of the mines departments of the different states is shown in the accompanying table, in fine ounces:

GOLD PRODUCTION OF AUSTRALIA
(In Fine Ounces)

	1912	1913	1914
Western Australia	1,282,658	1,314,044	1,232,973
Victoria	480,131	434,932	409,706
Queensland	347,946	265,735	248,395
New South Wales	165,295	149,658	124,507
Tasmania	37,973	33,400	27,320
South Australia	7,340	7,292	6,000
Total, ounces	2,321,343	2,205,061	2,048,901
Total, value	$47,982,150	$45,578,611	$42,350,784

The total decrease in 1914, as compared with 1913, was 156,160 oz. or 7.1%. The maximum production was in 1903, when the gold output of Western Australia was at its height. The production reported in that year was 3,837,064 oz., or almost double that of 1914. All the states showed decreases last year, with little differences in proportions.

The report for the Northern Territory has not yet been published. This production was 14,681 oz. in 1913, when it was stated separately for the first time. The New Zealand report for 1914 is also missing to make up the production for all Australasia.

Mineral Production of Spain for 1913

According to *Revista Minera* of Feb. 24, 1915, the mineral production of Spain for 1913 has been made public by the Department of Mines, and was as follows:

Substance	Metric Tons
Anthracite	232,517
Asphalt	5,582
Mercury	19,960
Sulphur	62,653
Barite	3,049
Bismuth	56
Zinc	171,831
Copper	2,268,691
Tin	6,626
Fluorspar	351
Iron (ore)	9,861,668
Iron (pyrite)	926,913
Bituminous coal	3,783,214
Kaolin	5,263
Lignite	276,791
Magnesia	958
Manganese (ore)	21,594
Silver (ore)	402
Lead (ore)	279,078
Lead (argentiferous)	23,600
Salt	26,238
Soda (sulphate)	293
Vanadium	25
Wolfram	235
Uranium	1
Wulfenite	40

Nevada Safety Requirements

By A. L. H. Street*

A mining company is liable for injury to a miner resulting in direct consequence of the company's failure to comply with the requirement of the Nevada statutes that iron-bonneted safety cages be used in vertical shafts which are deeper than 350 ft. In reaching this decision recently in the case of Ryan vs. Manhattan Big Four Mining Co., 145 *Pacific Reporter* 907, the Supreme Court of Nevada held that an injured employee could not be deemed to have assumed the risk of injury resulting from his use of a bucket as a cage with knowledge that his employer was violating the safety law. But the court makes it plain that the mere fact that the law is not complied with and that a miner is injured does not establish liability against the mining company; it must appear that the accident would not have happened except for the violation.

*Attorney, St. Paul, Minn.

NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

AGITATOR. John Van Nostrand Dorr, Denver, Colo. (U. S. No. 1,131,222; Mar. 9, 1915.)

CADMIUM—Removal of Cadmium from Zinc Ores. Gilbert Rigg, Palmerton, Penn., assignor to the New Jersey Zinc Co., New York, N. Y. (U. S. No. 1,129,904; Mar. 2, 1915.)

CONCENTRATION—Improvements in or Relating to Method and Apparatus for Concentrating Ores. G. E. Ohrn, Lidingo, Stockholm, Sweden. (Brit. No. 22,346 of 1913.)

COPPER AND NICKEL—Process of Separating Copper from Nickel and Matte and Other Products. Noak Victor Hybinette, Christiansand, Norway, assignor, by mesne assignments, to National Trust Co., Ltd., Toronto, Canada. (U. S. No. 1,128,313; Feb. 16, 1915.)

COPPER CEMENTATION—Anode for Electrolysis. Noak Victor Hybinette, Christiansand, Norway, assignor to Pacific Securities Co., Ltd., Toronto, Canada. (U. S. No. 1,128,316; Feb. 16, 1915.)

COPPER-NICKEL ANODES—Process of Producing Copper-Nickel Anodes. Noak Victor Hybinette, Christiania, Norway, assignor to Pacific Securities Co., Ltd., Toronto, Canada. (U. S. No. 1,128,314; Feb. 16, 1915.)

CRUCIBLE FURNACE. Franklin M. Iler, Denver, Colo. (U. S. No. 1,129,983; Mar. 2, 1915.)

DRILLS—Front-Head Construction for Self-Rotating Hammer Drills. Lewis C. Bayles, Easton, Penn., assignor to Ingersoll-Rand Co., Jersey City, N. J. (U. S. No. 1,130,957; Mar. 9, 1915.)

ELECTRIC FURNACES—Method and Apparatus for Protecting the Electrodes in Arc Furnaces. Jegor Israel Bronn and Wilhelm Schemmann, Rombach, Germany, assignors to the firm of Rombacher Hüttenwerke, Rombach, Germany. (U. S. No. 1,129,377; Feb. 23, 1915.)

FILTER. Charles G. Osgood, Tonopah, Nev., assignor of one-half to the Montana-Tonopah Mines Co., Tonopah, Nev. (U. S. No. 1,128,495; Feb. 16, 1915.)

HAULAGE—Attachment for Ropes for Haulage and Like Purposes. Frederick Ringrose, Bothwell, and Thomas Stevenson, Hamilton, Scotland, assignors of one-half to Charles Fletcher Lumb, London, England. (U. S. No. 1,129,124; Feb. 23, 1915.)

HOISTING—Safety Attachment for Hoisting Machinery. George F. Royer, Wilkes-Barre, Penn. (U. S. No. 1,129,733; Feb. 23, 1915.)

HOISTING ENGINE. Sven T. Nelson, Chicago, Ill. (U. S. No. 1,129,044; Feb. 16, 1915.)

INGOTS—Process of Treating Ingots. Hiram W. Hixon, Philadelphia, Penn. (U. S. No. 1,130,513; Mar. 2, 1915.)

MAGNETIC SEPARATOR. George Ullrich, Magdeburg, Germany, assignor to Fried. Krupp Aktiengesellschaft, Grusonwerk, Magdeburg-Buckau, Germany. (U. S. No. 1,130,648; Mar. 2, 1915.)

METALLURGICAL FURNACE. Utley Wedge, Ardmore, Penn. (U. S. No. 1,131,449; Mar. 9, 1915.)

MINING-TOOL CAR. Edward Pyle, Butte, Mont. (U. S. No. 1,126,862; Feb. 2, 1915.)

ORE REDUCTION—Process of Reducing Ores. Albert E. Greene, Chicago, Ill. (U. S. No. 1,129,862; Mar. 2, 1915.)

ORE-SEPARATING AND CONCENTRATING MACHINE. William P. Clifford, Ottumwa, and John C. Cook, Russell, Iowa. (U. S. No. 1,128,850; Feb. 16, 1915.)

RADIUM—Metallurgical Process. Louis F. Vogt, Washington, Penn., assignor to Standard Chemical Co., Pittsburgh, Penn. (U. S. No. 1,129,029; Feb. 16, 1915.)

SLAG-HEATED STEAM GENERATOR. Utley Wedge, Ardmore, Penn. (U. S. No. 1,129,928; Mar. 2, 1915.)

SLAGS—Process for Removing Slags from Furnaces and Means for Carrying Out the Same. Karl Prinz zu Loewenstein, Neckargemünd, Germany. (U. S. No. 1,128,255; Feb. 9, 1915.)

STAMP STEM GUIDE. James A. Little, Randsburg, Calif. (U. S. No. 1,127,653; Feb. 9, 1915.)

VANADIUM—Treatment of Vanadium Ore. Louis F. Vogt, Washington, Penn. (U. S. No. 1,129,253; Feb. 23, 1915.)

Editorials

Robert Hallowell Richards

The presentation of its gold medal by the Mining and Metallurgical Society of America to Dr. Robert H. Richards last week was a graceful and appropriate recognition of one who has rendered distinguished service both in the education of mining and metallurgical engineers and in the advancement of the art of ore-dressing. Professor Richards, who has been identified with the Massachusetts Institute of Technology for half a century, was the first to create the system of mining and metallurgical instruction with the aid of a laboratory, equipped with working machines, wherein the students were taught to execute the lessons of the lecture-room; and thus blazed a trail in technical education which other teachers were glad to follow, which now they have converted into a broad, well marked road. For this, if for nothing else, Professor Richards is entitled to the thanks of the profession.

But in the specialty that he made his own—ore-dressing, or the mechanical concentration of ores—he has rendered service of equally altruistic character but far broader scope. He has been a developer of principles in an art that was destined to become the premier in importance, a codifier of its rules, and the exponent of both theory and practice in a field that was practically uncharted. His monumental treatise on ore-dressing was not only the first in the English language, but for many years it was the only one and is still the principal one.

Professor Richards has been essentially a teacher, but he has been able to put his teachings into practice and has invented two noteworthy machines—the Richards pulsator and the Richards jig—which have come extensively into use. It is sincerely to be hoped that Professor Richards will reap a larger material reward from these valuable inventions than yet he has gained. But throughout his life his personal interests have ever been subordinated to those of his work as a teacher and as a guider of men. To such leaders come rewards of a kind that money cannot buy. It was fitting that the Mining and Metallurgical Society of America should this year bestow its medal "for distinguished service" upon Robert Hallowell Richards.

The Smelting Company's Report

The American Smelting & Refining Co. has signalized 1915 by bringing out its annual report, covering 1914, in a new form. In the past we have often taken occasion to criticize the reports of this company, not because they did not make a good exhibit or show to its stockholders how their property stood, but rather because they failed to tell the stockholder what kind of a business it was doing and enable him to form some sort of an idea respecting future prospects. In the report for 1914 the directors have made revelations that will interest everybody, and indeed will surprise everybody with respect to the magnitude and the diversity of the business done by this great company.

The cash receipts of the company from sales of products and miscellaneous income were $187,504,400. The expenses for ore and bullion purchased and the cost of treating them were $173,864,673, a difference of $13,639,727; but metals were sold to the amount of $1,820,606 more than were purchased, wherefore the operating profit was apparently $11,819,667. In its statement of "income" the company puts it at $12,825,530. This was derived from (*a*) smelting and refining, (*b*) mining, (*c*) manufacturing and (*d*) from rents, interest and commissions. From rents, interest and commissions the company got $1,222,514. This comprises interest received on its large cash balances and commissions derived from the sale of Nevada Consolidated, Utah, Ray and Chino copper. The receipts from manufactured products were $2,665,957. These comprise such things as sulphuric acid, made at Perth Amboy; copper sheets, rods, tubes, etc., made at Baltimore; and white lead, sheet lead, etc., made at Selby. The company's statement does not make it clear just how these are reckoned. Inasmuch as its own products were manufactured we assume that the amount stated represents the value added by manufacture. There is a similar doubt with respect to the $3,135,809 received from mining properties, but the "income" statement makes this clear by giving $935,193 as the net from the mines. The net earnings of the smelteries, refineries and factories were $10,667,822. In order to find the total operating profit, however, there should be deducted from the total gross income ($12,825,530) the sums of $924,683 for administration, $175,859 for corporate taxes, and $1,540,350 for depreciation, leaving a net income from operations of $10,184,638, of which we may assume that something like $8,000,000 to $8,500,000 was derived from smelting, refining and manufacturing. But in fact the business of this company is so complicated as to defy analysis on the basis of figures presented in this report, and perhaps by anything short of an examination of the accountant's books.

Take the smelting and refining business alone. The company operates copper refineries and lead refineries. It refines its own bullion and purchased bullion and some that is handled on toll. It operates lead smelteries, copper smelteries and zinc smelteries, which treat ores purchased, ores mined by the company itself, and a large tonnage of ore, especially that of the Utah, Chino and Ray companies, that is simply smelted on toll. The coke used in the smelteries is to a large extent made by the company out of coal that it mines itself. It is therefore difficult to distinguish among its earnings as a coal and ore miner, a coke manufacturer, a copper, lead and zinc smelter, a copper and lead refiner, a manufacturer of lead and copper wares, a selling agent, an operator of steamships and a capitalist.

In 1914 it employed 12,179 men, who earned an average of $2.33 per eight hours, not including the employees in Mexico. It smelted 4,171,258 tons of charge and refined 588,718 tons of bullion, out of which was produced 529,686,000 lb. of copper, 316,591 tons of lead, 2,540,911 oz.

of gold and 77,604,483 oz. of silver. Of fuel there was used 447,761 tons of coke, 544,619 tons of coal, 976,528 bbl. of oil and 7,430,300 cu.ft. of natural gas (for zinc smelting). The company itself produced 129,650 tons of coke and 257,942 tons of coal. As a miner of silver-lead and copper ores it produced 1,266,702 tons. The report does not specify whether the last figure measured crude ore or concentrated ore, but probably the former is meant.

It would be interesting if the company in its future reports should dwell more fully upon its mining business, stating just how much ore passes from its mines to its smelteries and how much metal is derived from them. Apart from its own ores the company is simply a middleman in the handling of ores for other persons, taking them in and disposing of their products, making a charge for the conversion out of which comes its profit. Theoretically it does not matter whether the company purchases the ore from the producer or treats if for him on toll. This is chiefly a matter of the convenience of the producer. The large producer, with ample capital, may prefer to have his metals returned to him for sale by himself. The small producer, on the other hand, is likely to lack both the means of selling for himself and the capital for carrying on his business in that way, wherefore the smelter becomes in effect his agent and banker. This was exemplified last fall, when for a time there was no sale for copper and silver and the A. S. & R. Co. made advances to the producers thereof, to which reference is made in the report and this is what Mr. Guggenheim means when he says that the company endeavors to make sales of its metals at the same price at which they were purchased and is not financially interested in the market price for its products.

What interests the company most is to keep its plants operating at as nearly maximum capacity as possible, wherefore it is to its advantage to encourage the maximum production of ore. In this it is aided by extracting all possible byproducts from the ores and reducing the cost of treatment to the minimum. By every economy that the smelter effects the miner profits through the smelter's ability to receive a lower and lower grade of ore.

The Steel Corporation s Year

The report of the Steel Corporation for 1914 shows that its business for the year reflected pretty closely the general conditions of the iron and steel trade. If anything the Corporation's results were below those secured by the larger independent companies rather than above them. The depression of the earlier months of the year and the general dullness of trade were fully manifested in the earnings, while the disorganization caused by the war entirely demoralized the export trade which had been built up with so much labor and expense. With a diminished business there was naturally an increased ratio of expenses, the total of all operating and renewal charges for the year having been 85.4% of the gross receipts. The net earnings, from which interest charges had to be paid, were actually $1,722,909 less than the 7% dividends on the preferred stock; and the dividends on the common stock, though cut from 5 to 3%, were paid wholly out of the accrued surplus. This is discouraging enough, but it can hardly be expected that another year will unite in itself so many unfavorable factors and there are already signs of a marked improvement in the current year.

Comparing results in 1914 with those of 1913, we find that the total decrease in sales and deliveries was 26.7%, the loss in domestic business being 25.2% and in foreign trade 36.9%. The foreign trade was only 11.2% of the total, a considerable falling off from the preceding year. The report, although very full in its financial details, does not give sufficient data to enable us to compute costs of the material sold. It does state that the lower prices realized contributed to the decrease in earnings, as well as the falling off in business. In 1914 the average realized on finished material sold, it is stated, was $2.54 per ton less than in 1913. This does not appear fully in the results as the value of the total sales in 1914 decreased 26.7%, as stated above, but the tonnage of sales fell off 25.4%; indicating that the proportion of the higher-priced products must have been larger in 1914 than in the preceding year.

That the Corporation managers are hopeful for the future is evident from the fact that work on new plants and extensions was not discontinued, $23,171,013 having been expended on them in 1914. The largest item is found in the new steel plant at Duluth, for which one-fifth of this improvement fund was paid. Another sign of this hopefulness is found in the fact that no step was taken toward reducing wages. In fact there was a slight increase, the average wages per day for all employees having been $2.97 in 1914, while it was $2.92 in 1913. The magnitude of the operations is illustrated by the fact that although there was a reduction of 21.6% in the total number, 179,353 men were employed in 1914. The number in the preceding busy year was 228,906 in all. Nearly three-quarters of the whole force—73%—were employed in the manufacturing plants; 15% in iron-ore and coal mining; and 12% in transportation and miscellaneous activities.

In previous years the Steel Corporation has furnished close to one-half of the finished-steel production of the country, its proportion varying from 46 to 57%. For 1914 we have not yet the data on which to base the calculation, but the pig-iron production was 43.1% of the total reported for the United States. The blast-furnace output was always the weaker side of the Corporation's activities, and finished steel will probably reach a slightly higher proportion.

On one point the report is silent. While noting the termination of the Hill ore-land leases, nothing is said of the results of those leases beyond the brief statement that the ore mined has slightly exceeded the minimum provided for in the contracts. The total ore shipped from those properties was 26,573,808 tons. The total expenditure is not stated, but there is little doubt that this was high-priced ore, when all the conditions are taken into account. The surrender of the leases still leaves an abundant supply of ore available from the properties of the Oliver Iron Mining Co. in Minnesota and Michigan.

The report, like those of previous years, is full of financial details, but it is weak on the technical side. A brief and condensed list of improvements made in the various plants is given, but beyond that there is no information as to the technical activities of the year. It is possible that such details might have increased the size of the report too much, and that the financial results are what stockholders look for. It can at least be said for the Steel Corporation that the management is not secretive and that

information of any important improvements is generally accessible to the technical world, if it is not conveyed in the annual report.

The Situation in Tin

One week ago, on Mar. 17, the price of spot tin in London was £194 for Straits and £190 for Standard. Today it is £172 for Straits and £168 for Standard, a fall of £22 per ton. The high price reached in London has for some time been looked at askance by authorities in the trade here and the slump was not unexpected. The whole situation is involved and complex and predictions concerning the future are extremely hazardous, but certain factors which have played a part in the movement are readily apparent and easily susceptible of analysis.

The rise in London was chiefly on spot and nearby tin, and was partly due to the increased quantities tied up in transportation through the slower movement of ships and the congested condition of the docks in London. Something like 5000 tons of tin above normal was rendered unavailable to the market in this way. A far greater influence, however, was the heavy demand on London for shipment to Scandinavia and Holland. This tin, supposititously, was to supply the domestic requirements of those countries, or for Russian account, and certain restrictions were thrown about its shipment intended to prevent the tin finding its way into "enemys' country."

The price of tin in Germany attained very high figures, ranging anywhere from £200 to £250 per ton, and despite precautions taken by the Admiralty in London this high price attracted large quantities, especially during the last few months. Nearly as much in fact went to Germany as in times of peace and the German price suffered a heavy fall in consequence.

The English authorities seem to have been very slow in waking up to what was going on, but finally becoming aware of conditions have now surrounded the exportation of tin not only from England but also from the Straits with such stringent regulations that it would seem impossible for further quantities to reach Germany; and the fall in London is attributed to the resale of lots previously bought for export but which probably cannot now be shipped out of England.

Other factors that played an important part in raising the London price since Jan. 1 were due to prior causes, one of the chief of which was the interruption to shipments from Bolivia, owing first to the disorganization entailed by the war, and later to the activities of the German fleet off the west coast of South America. Since shipments have been resumed nearly 7000 tons of Bolivian tin have arrived in England which is more than arrived there July to December, inclusive. This will restore to the market not only as much as it formerly received from this source, but a large quantity in addition. The average arrivals in Great Britain from Bolivia were formerly not in excess of 1200 tons per month.

The part that Holland has played in occasioning the recent stringency in London is also shown on an examination of the figures, according to which their total sales August to December, inclusive, amounted to only 3000 tons, most of such sales being from stocks in Holland and going to Germany. Their sales otherwise in November, December and January amounted to only 268 tons. In February, however, from stocks in Java the Dutch Government sold 2000 tons of Banca and Billiton tin, and to the middle of March had sold something like 1500 tons additional. Much easier conditions will necessarily ensue when these large shipments reach the consuming markets.

There seems no escape from the conclusion that the recent scarcity and high prices will soon be a thing of the past. With Germany excluded as a consumer and the London exports confined to the domestic requirements of the other countries of Europe, demand must undergo a substantial shrinkage. The total consumption of Holland, Sweden, Denmark and Russia is only about 4500 tons per annum or say 400 tons per month. Three or four times this quantity has been shipped from London monthly of late, the difference going to Germany.

As to the future, figures have been offered to prove that with Germany eliminated the position of tin is anything but strong; in fact whether or not the markets are accessible to her, that supplies are actually in excess of demand. In the first place it must be borne in mind that tin plays but a small part in the arts of war while war's damage to the arts of peace is enormous. In the United States, for instance, during eight months of war ending with March, deliveries will show a decrease of about 4000 tons, or 15%. In Great Britain exports of tinplate January to February shrunk from 84,000 tons to 54,000 tons, or about 33⅓%.

The chief difficulty we have to combat in the United States is one of transportation. As soon as that problem is solved there will be plenty of tin available for local consumption, and the restrictions surrounding exports from London which at present embrace America will doubtless be removed shortly, permitting free movement to this side. Steps to that end have already been taken. Meanwhile, supplies on the spot are scarce but the demand seems to be light, only small lots changing hands at about the prices stated in our market report. Owing to the scarcity local prices have so far been little affected by the fall in London, but it is needless to say that with the first signs of larger imports the parity between the two markets will be restored and a drop of somewhere between 10 and 15c. per lb. is not unreasonably to be expected.

BY THE WAY

Practically the whole of the first battalion of the Artists' Rifles, a corps formed by young professional men of every line, will soon be commissioned as second lieutenants in the British army. Among them, says a London dispatch, are several young American mining engineers employed on the Guggenheim properties in South America, who came to England to enlist because of a feud with the German chemists in the assay department of the mines. This makes interesting reading but, unfortunately, it belongs to the "interesting if true" class. A number of Europeans were engaged in the construction work of Guggenheim properties in Chile at the outbreak of the war and some of these young men, particularly a number of Englishmen and Frenchmen, returned to their respective countries to join the colors. So far as we have been able to learn by casual inquiry, none of the Americans left Chile for this purpose, but we hate to spoil a good story by pursuing the inquiry to the bitter end.

PERSONALS

Frank D. Klinglund, superintendent of the Empire Iron Co., Negaunee, Mich., was in Chicago recently.

W. H. Aldridge, who has been making a trip through Chihuahua, expects to be back in New York about Mar. 29.

Fred W. Denton, manager of Copper Range Consolidated mines, has returned to Michigan after three weeks' vacation.

John Knox, general superintendent of the Calumet & Hecla and subsidiaries, has gone to San Francisco for a month's vacation.

Henry M. Payne, consulting engineer to the Canadian Klondike Mining Co., will leave New York about April 1 for the Yukon.

Homer L. Carr has returned to New York from Honduras where he has been engaged for several months on a placer examination.

C. H. Benedict, milling expert for the Calumet & Hecla Mining Co., passed through Chicago on Mar. 16, on his way to the copper country.

Scott Turner, European manager for Ayer & Longyear, with mines in Spitzbergen, passed through Chicago on Mar. 17, on his way to Minneapolis.

S. W. Ough, superintendent of the Maravillas y San Francisco mill in Pachuca, has left Mexico with his family and will return to England soon.

Eugene A. J. Goldschmid, chairman of the Central Chile Copper Co., is on his way to Panulcillo, Chile, for an inspection of the company's properties.

Oscar Lachmund, general manager of the British Columbia Copper Co., Ltd., Greenwood, B. C., passed through Chicago recently on his way to New York.

R. R. Seeber, superintendent of the Winona and Houghton Copper companies, in the Lake Superior copper district, spent several days in Chicago last week.

Herbert C. Shotwell, mining engineer with office in Prescott, Ariz., was in Chicago on Mar. 19, in the interests of a consolidation of two Arizona gold properties.

Boyd B. Jack, late with the Inland Steel Co., Indiana Harbor, Ind., has been given charge of the new sheet mills of the Empire Rolling Mill Co., Cleveland, Ohio.

George E. Hooper, superintendent of the Victoria mine, in the Michigan copper country, spent several days in Chicago on business, during the week of March 15, on his way from Boston to Michigan.

David H. Ladd, of Houghton, Mich., has been in New York on his way to London where he will make his home in the future, acting as selling agent for the Wallaroo & Moonta Copper Co. of Australia.

L. P. Alford, editor of the "American Machinist," read a paper entitled "Some Machine Tool Developments of 1914" at the meeting of the Cleveland Engineering Society in Cleveland, Ohio, Mar. 23.

Baylies C. Clark has been appointed Secretary pro tem. and Superintendent pro tem. of the Bunker Hill Consolidated Mining Company during the absence of Mr. Hampton, who is on leave on account of illness.

James Aston, metallurgist, connected with the University of Cincinnati, has resigned to enter the service of the U. S. Bureau of Mines. Mr. Aston will be commissioned to carry out an investigation of safety and efficiency in steel plant operation.

L. G. Sicka has resigned his position as mechanical superintendent of the Tooele plant of the International Smelting Co., and has accepted a more important one as mechanical superintendent and engineer for the St. Joseph Lead Co., Bonne Terre, Missouri.

H. V. Winchell of Minneapolis, Minn., and J. R. Finlay of New York have been retained as mining experts for the Jumbo Extension Mining Co. of Goldfield, Nev., in the apex litigation instituted against it by the Reorganized Booth Mining Co. of Goldfield.

Wm. J. Kee, Jr., for the past four years superintendent of the Argentine acid plant of the National Zinc & Chemical Co., formerly United Zinc & Chemical Co., has resigned to become connected with the new acid plant designed by Utley Wedge for the Anaconda company, at Anaconda, Montana.

OBITUARY

James Tregenza, head blacksmith for the Champion mine of the Copper Range Consolidated, died at his home at Painesdale, Mich., aged 53 years. Mr. Tregenza was born in England and came to this country in early youth. He has been a blacksmith miner ever since, working first in New Jersey and Pennsylvania, going to the Michigan copper country 25 years ago. He was employed at the Champion for 10 years, before that at the Atlantic mine.

Frederick W. Taylor died in Philadelphia, Mar. 21, aged 57 years. He was born in Philadelphia and had his early training in the Sellers machine shops and the Midvale Steel Works. He was widely known as the originator and earnest advocate of the modern science of efficiency engineering, on which he wrote several books. He was also well known for his experiments and improvements in the manufacture of tool steel. He was a past president of the American Society of Mechanical Engineers, vice-president of the mechanical engineers' section of the American Association for the Advancement of Science, a member of the Society for the Promotion of Scientific Management and of the American Philosophical Society.

SOCIETIES

New Mexico School of Mines—This school at Socorro anticipates an enrollment next year of 100 students and an appropriation from the Legislature which will permit power and machine shop installation. President Jones will issue for public use, April, University bulletin on the "Economic Geology of New Mexico" and with it a companion bulletin on "Rare Ores of the State." The two combined will be an official state publication of the mineral resources.

INDUSTRIAL NEWS

The Standard Silver-Lead Mining Co. is installing one 5x6-ft. Chalmers & Williams adjustable quick-discharge tube mill.

The Northern Chemical Engineering Laboratories announces the adoption of the name, C. F. Burgess Laboratories. The new name implies no change in management or ownership.

El Arco Mines of Mexico has purchased an adjustable quick-discharge Chalmers & Williams tube mill, together with Nissen stamps and other equipment for its new plant in Sinaloa, Mexico.

The Royal Manufacturing Co. of Rahway, N. J., is aiming to put the cotton and wool waste business on a scientific basis by guaranteeing to ship by uniform grades, to ship bales of guaranteed uniform weight and to ship bales of uniform tare.

The Terry Steam Turbine Co. announces that after Mar. 22, its Chicago office will be in charge of A. W. de Revere, and located in the Peoples Gas Building. It has also opened an office in the Michigan Trust Building, Grand Rapids, Mich., in charge of A. L. Searles, to cover the southern peninsula of Michigan.

TRADE CATALOGS

C. O. Bartlett & Snow Co., Cleveland, Ohio. Bulletin No. 43. Ship Hoists. 8 pp., illus., 6x9 inches.

Cambria Steel Co., Morris Building, Philadelphia, Penn. Catalog. Slick Mine Ties. 42 pp., illus., 6x9 inches.

Bausch & Lomb Optical Co., Rochester, N. Y. Bulletin N-A. Engineering Instruments. 20 pp. illus., 6½x9½ inches.

General Electric Co., Schenectady, N. Y. Bulletin No. 48014. Mine Hoist Equipment. 32 pp., illus., 8x10½ inches.

Allis-Chalmers Mfg. Co., Milwaukee, Wis. Catalog. Some Interesting Pictures of Allis-Chalmers Tractor Trucks. 12 pp. illus. 9x12 inches.

Justrite Mfg. Co., Chicago, Ill. Catalog. 1915 Acetylene Lamps and Lanterns. 18 pp., illus., 3½x6½ inches. Jobber's Price List No. 16, Feb. 25, 1915. 2 pp., 6x10 inches.

Editorial Correspondence

SAN FRANCISCO—Mar. 18

Twelve Thousand Dollar Pocket discovery reported in San Francisco papers has been reduced to $12. The location which was said to be guarded with secrecy by the prospector is at Murphy's Ridge. There are plenty of pockets in Amador County where $12 can be discovered. Why is a newspaper reporter?

Resumption at Trinity Copper is thought to be indicated by the appointment of Frank M. Leland, general manager of the Balaklala Copper Co., as manager of the Trinity. The mines are near together in Shasta County and are controlled by the same interests. The Trinity has not produced extensively since the closing of the Balaklala smeltery and cannot resume full operations unless the Balaklala plant is blown in.

First-Aid Contests will be held under supervision of the U. S. Bureau of Mines at the Panama-Pacific Exposition Sept. 23 and 24. It will be a national meeting, invitations having been sent to all the mining states, and also to some of the Canadian mine operators inviting them to send teams to participate. Mr. Wilson, U. S. Bureau of Mines engineer, in charge of the safety department of the bureau, who is in San Francisco, met with the Metal Producers' Association recently and invited the association to take part in the arrangement and to make an effort to induce representations of the larger mines in California. The various committees have been selected, but until all of the members shall signify their intention of serving, the list is not available for publication. The bureau has a full equipment of first-aid and rescue-work paraphernalia on exhibition at the exposition, and also has an auto-truck fitted for rescue work. Demonstrations are given every afternoon at two o'clock and attract a good deal of attention.

BUTTE—Mar. 18

Changes and Improvements that will greatly increase the capacity of the Pittsmont smeltery of the East Butte Mining Co. and repairs at the mines that will put them in better shape for operation, are nearing completion, and the resumption of work at an early date waits now only on the arrival of some of the machinery. The smeltery has been entirely overhauled. One of the blast furnaces has been rebuilt and its capacity raised to 500 tons per day; the other furnace has a capacity of 300 tons. In the mill an elaborate system of slime-treating tables has been installed. In the mines a large amount of retimbering has been done to permit future mining at practically all levels between the 600- and 1500-ft. When the mine closed six months ago, the output was about 1,250,000 lb. of copper per month. The mines expect to start Apr. 15, and the smeltery probably Apr. 25.

The Pilot-Butte Company, on Mar. 12, was granted its motion, in the case of the Anaconda Mining Co. against it, to dissolve the temporary restraining order, issued on Feb. 14 last, which amended the one issued Oct. 8, 1914. The ground for dissolving the injunction was that what was asked for in the latter injunction was covered in the previous one. Thereupon the Anaconda company applied to the court for an order citing Paul A. Gow, superintendent of the Pilot-Butte, to show cause why he should not be punished for contempt in disobeying a restraining order issued by the court which was signed by Judge Lynch Oct. 20, 1913, prohibiting the Pilot-Butte company from operating in the Emily vein. The order was issued on the strength of an affidavit of Reno Sales of the Anaconda company who declares that Superintendent Gow ordered the work done and superintended the removal of the ore.

Mining Activity in Butte is increasing and it is expected that there will be between 11,000 and 12,000 men working in the various mines of the camp by May 1. This means a monthly payroll of about $1,150,000. Of the various operating companies, Anaconda, of course, leads with the employment of about 8000 men, Butte & Superior follows with 1100, North Butte with 600, East Butte with 500, Elm Orlu and Timber Butte with 500, and with 8000 employed in the other smaller mines. The active mines of the Anaconda company now are the Anaconda, St. Lawrence, Steward, West Gray Rock and East Gray Rock, Original and Gagnon, Badger State and Moose, West Colusa, East Colusa, Leonard, Tramway and Rarus, J. I. C., Berkeley, Silver Bow and the Poulin. The mines that are still down are the Neversweat, Mountain Con., Diamond, Belmont, High Ore, Moonlight, Mountain View and Pennsylvania.

Butte-Duluth in the Hands of Receivers as the result of a friendly suit filed for the purpose of conserving the interests of the creditors, bondholders and stockholders. Charles M. Everett, secretary of the company, was appointed receiver of the properties by Judge McClernan Mar. 16 on the application of the Provident Securities Co. of Delaware, holder of three fourths of the stock of the Butte-Duluth company, and A. Purdy, who as an employee of the company has $500 in wages due him. Operations will continue under Receiver Everett. Individual suits which were threatened by numerous creditors will thus be avoided. The liabilities of the company consist of about $250,000 of floating debts, in addition to a mortgage of $500,000. Most of the indebtedness was incurred in the construction of the new plant and in the continued operations during the hard times of the past eight months. Some months ago Captain Wolvin proposed to his employees that if they would take half their pay in cash and the balance in due bills to be paid when the market became normal again, he would try to raise the funds to pay the cash part of the proposition.

SALT LAKE CITY—Mar. 18

The Utah Mining News, a new local paper, was issued for the first time on March 11. L. G. Schwalenberg, formerly of the "Ely Expositor," and L. E. Camomile, of Salt Lake, are at the head of the enterprise.

Lands Withdrawn from Entry in this state when conservation was at its height, are being gradually restored to entry by Secretary Lane. Since the first of the year 270,000 acres withdrawn as coal lands have been restored.

A Banquet to Samuel Newhouse will be given by members of the Salt Lake Stock & Mining Exchange as a mark of appreciation for what he has done for the exchange, making a gift of the building site, and other favors. The banquet will be held at the Newhouse Hotel shortly after the opening, about the end of March.

The Extensive Resources of the State in copper, coal, iron, alunite (potash), carnotite (radium), salt, sulphur, gypsum, various hydro-carbons, agriculture, etc., and the opportunities for investment in these, many of which are undeveloped, were called to the attention of capital and the public by the state legislature in a resolution adopted at the close of the present session, Mar. 11.

Four Large Coal Companies, the Castle Valley Consolidated Fuel, Black Hawk and Panther, owning extensive coal lands and producing mines in Carbon and Emery counties, are to be consolidated into one company, to be known as the United States Fuel Co., capitalized at $10,000,000, of which $3,000,000 is preferred stock, and $7,000,000 common. The mines and mining property will be placed under one management. E. L. Carpenter is to be president.

Open Hostilities in the faculty of the University of Utah led to the resignation this week of 14 professors and instructors, including two deans and three heads of departments. This followed the action of the board of regents in sustaining President Kingsbury and refusing to order a public investigation of the reasons for the dismissal of four professors and the demotion of a fifth, and the curtailment of the duties of a sixth. The movement among the members of the faculty which resulted in yesterday's resignations, is asserted to be part of a program conceived to oust Dr. Kingsbury as president of the university. Among the reasons assigned for their action by the professors and instructors who resigned, is lack of harmony, the right of free speech curtailed and coercion. Many of the professors stated in their resignations that they did not feel sure of their positions, and that good work could not be accomplished unless there was reason to believe they would have employment for more than one year. The period of service at the university of those who resigned runs from one to 20 years. The sentiment of the students seems to be about equally divided in regard to the stand of the regents and the 14 resignations.

SEATTLE—Mar. 17

Reports from Shushana are that the McCarthy-Bonanza trail over the glacier is in bad shape. One party took three weeks to make the round trip, less than 200 miles; five successive days being spent stormbound near the glacier. Under more favorable conditions the trip has been made, one way, in 15 hr. actual traveling.

Ruby is Optimistic on account of the excellent results obtained from the large amount of winter work that is being done. Paystreaks are, for the most part, irregular, and the pay is spotted, but the spots are rich enough to make up for the low-grade areas. Good prospects are reported from Spruce and Solomon creeks and pay has been located at intervals for three miles on Tamarack.

Outlook for Tolovana District is more promising since reported strike of pay on Casey Creek, a small tributary entering the Tolovana about 18 miles above the mouth of Livengood Creek, on which was made the strike that precipitated the recent stampede. Depth to bedrock on Casey said to be 30 ft., with 6 ft. of gravel panning 10c., or $4 per sq.ft. of bedrock. Report has not been verified. On Livengood and nearby creeks there is much prospecting, but no authentic report of pay has yet been made.

LORDSBURG, N. M.—Mar. 19

The Road Between Silver City and Mogollon will be repaired or constructed as a result of two important forces that have materialized. One is the passage of a bill in the state legislature, declaring the road a state highway and providing a tax levy for maintaining it. The other is the activity on the part of the mining companies of Mogollon and the business men of Silver City. The Mogollon companies have subscribed $6000 and Silver City plans to subscribe a similar amount to be spent on the Grant County part of the road. The Mogollon money is to be spent on the Socorro County division. The most pressing need is a bridge across the Gila River. At the present time the Lyons cable-way is transferring freight and passenger automobiles across the stream. Another bill was enacted, creating a state highway between Hondo in Lincoln County and Mogollon and providing for a tax levy to construct a part thereof and authorizing the Socorro County commissioners to solicit and receive contributions for the remainder. The Mogollon mining companies have suffered greatly from the lack of adequate transportation facilities and during the past winter work was carried on only spasmodically. At times it was impossible to get any form of supplies into the camp and the supply of fuel oil was exhausted several times. The poor roads have been one of the camp's greatest hindrances to progress and both mining companies and shippers see the need of immediate effective action.

GOLDFIELD—Mar. 18

The Apex Litigation in Goldfield is discussed by George Wingfield as follows: "I have kept litigation out of this camp for 10 years. Now that litigation has been forced on me I am going to be fair in every respect and try our lawsuits in the courts and not in the newspapers. It is not my disposition to work hardships on innocent stockholders of any of the local companies in which I am or am not interested. It is my intention to give stockholders of companies in which I am not interested the same consideration I give to those of companies in which I am interested. It is not my disposition to stop work in this camp. I am very deeply interested in the welfare of Goldfield; therefore, it is my disposition to encourage work in every way, and that is why I consented to the stipulation entered into between the Reorganized Booth Mining Co. and the Jumbo Extension Mining Company."

JOPLIN—Mar. 20

The Largest Drainage Project that has ever been undertaken in the Joplin mining district is the draining of approximating 800 acres of mining land lying south of Carterville and east of Webb City. On this tract are a number of old mines, formerly worked extensively but at present full of water. This work has been undertaken by T. J. Franks and associates who have organized under the name of the Zinc Corporation. The work of pumping this large quantity of water from the old mines on this tract presents quite a difficult problem. In addition to pumping against a considerable head the water is so strongly acid, that it precludes the use of cast-iron pumps and pipes. Pumps of bronze and wooden discharge pipes are being used. Two 6-in. centrifugal pumps have already been installed and are in operation and additional pumps are being put in as rapidly as possible. The pumping capacity will exceed 5000 gal. per min. The complete unwatering of this tract will provide an area in which there are two well defined deposits of ore that have been proved by former mining operations. The first is the soft-ground or disseminated deposit extending from the 75-ft. level to a depth of 175 ft., the second is the sheet-ground extending from 190 to 230 ft. deep. In 1905 there were several mills operating on ore taken from this tract, but they were shut down on account of a flood which came in the spring of that year filling all the mines with water, some of which were subsequently partly drained but others have not been touched since. Adjoining this land on the south are the properties of the American Zinc Lead & Smelting Co. and the Continental Zinc Co., who have mined extensively in the sheet-ground. On the west lie the numerous rich mines on what is known as Sucker Flat. On the north is the rich tract of the Center Creek M. Co. which holds the district's record for value of ores produced.

KELVIN, ARIZ.—Mar. 17

Tailings in the Gila River, said to originate in camps at Mogollon, N. M., and discharged into the Gila by the Frisco River, are becoming a serious menace to the lands in the Gila Valley, and canal companies are taking steps to stop the evil. A meeting of the directors of the San Jose, Union and Montezuma canal companies was held recently at the office of water commissioner Colton to discuss the matter.

PHOENIX, ARIZ.—Mar. 17

Mining is at a Low Ebb in this section of Arizona and has been for some time, but there are evidences of increased activity soon. The Governor is quoted as having said that he will soon call an extra session of the State Legislature. There are good reasons for believing that it will not pass any laws which will hamper the Arizona mining industry.

HOUGHTON—Mar. 20

Rush Shipments of Copper continue to leave the Lake Superior district. Opening of navigation will find comparatively little metal on hand. Lake Superior copper is specified in practically all of the war munitions and that is using up most of the output from this district at present. Over 10,000,000 lb. have been shipped out by rail thus far this month. This breaks the record for all-rail shipments in March in the history of the industry. Trains carrying a million pounds of metal are not infrequent. Every smeltery yard is bare of metal, except one. The Calumet & Hecla smelting and milling plant has increased its working force 25% in the past 30 days. Two additional furnaces went into commission this week, making 10 running at present.

TORONTO—Mar. 20

The Calgary Oil Excitement has been renewed by an important strike at well No. 2 of the Alberta Petroleum Consolidated, Mar. 14. The well struck oil at a depth of 2774 ft. and had oil 900 ft. deep in the bore on the evening of the strike. The oil is heavier than the product of the Dingman well and of a dark olive green color.

The Change in Management of the Dome made at the meeting held in New York on Mar. 19 when Captain J. R. DeLamar succeeded Ambrose Monell as president was the most interesting development of the district during the past week. The spectacular rise in Dome stock from $6 a share to over $11 is largely accounted for by this change although the improved condition of the mine on the lower levels enters into the explanation. Mr. Monell, who is president of the International Nickel Co., has never taken any interest in the stock market end of the business and a number of shareholders believe that the stock has been left to the mercy of the traders to the detriment of the stockholders' interests. Under Captain DeLamar who is one of the most spectacular mining operators in the United States, it is expected that there will be a wider market for the stock and higher prices than have prevailed for the past year. The change in the presidency may also result in a dividend being declared at the next annual meeting.

OTTAWA—Mar. 20

Much Activity in Mining has compelled the Mines Branch of the Department of the Interior to increase its office force in order to cope with the increased official business due to the discoveries of gold on the shores and bars of the North Saskatchewan River. Mining of gold in the sands and gravels of the river beds is being energetically pursued by use of the old-fashioned rocker which shows that the dirt must be rich, otherwise there would be no profit in such work. In the early Yukon days anything less than a 10c. pan was not profitable for the grizzly and rocker methods, though later 2½ to 3c. pans were considered favorable. The Saskatchewan will not average anything near 10c. pans, but 2 to 5c. pans are common, and pay the miner fairly well.

The Mining News

ALASKA

CHATHAM CREEK MINES CO. (Fairbanks)—Closed down about a year ago owing to pinching of orebody at water level and lack of funds for deeper prospecting. New company expects to start work in near future.

HANSEN & MAGNUSSON (Chatanika)—These operators, who recently found good pay on Vedine ground near Chatanika, have shipped to property complete working plant including 40-hp. boiler, Lidgerwood double-cylinder hoist, cable, carrier bucket, pipe, points, and car-load of lumber. Plant will be set up immediately and ground opened for summer mining.

MOTHER LODE COPPER (Kennecott)—Situated near famous Bonanza in Copper River belt employing 40 men. Equipment installed last summer includes gasoline engine, air compressor, machine drills, etc. Leschen aërial tramway conveys ore from portal of Marvelous tunnel to McCarthy Creek flats, distance of 7000 ft. Tram is in two sections and has capacity of 5 tons per hour when using 14 buckets, can be increased to 15 tons by using more buckets. Ore is hauled from discharge end of tram to shipping station on Copper River railway by horses.

ALASKA GOLD (Juneau)—D. C. Jackling, now in Alaska, wires: Everything here is in most excellent shape. The mill is doing splendid work. Both the tonnage treated and the recoveries are fully up to my expectations. When finally adjusted a section will handle 2500 tons, giving a capacity of 10,000 tons to the entire plant. That the recoveries will be fully as good as determined by our experimental results is now certain. The second section will be ready in 60 days and the mine will be sufficiently opened by that time to furnish the tonnage for it. The third section should be started about July 1. The ore we are now milling is coming from six different and widely separated points in the mine, thus giving us a good average of the property, and is holding at nearly $2 per ton, and we are treating 1800 tons per day. The tonnage for the month of March should be about 40,000 tons. The mill is the simplest and most economical in all points and the most satisfactory one we have ever built.

ARIZONA

Cochise County

CALUMET & ARIZONA (Warren) — Reported to have changed original plans for railroad from new porphyry subsidiary, New Cornelia, at Ajo, to Gila Bend; now planning to tap main line at Tucson, distance of 100 miles. Cornelia plans to change its character to permit mortgaging of its property to accommodate financing of permanent development and equipment. One-ton experimental leaching plant operated continuously for practically six months. For last 74 days plant gave an extraction of 80.07% of copper contained. A 40-ton plant just completed, now in operation. If this plant duplicates results obtained in one-ton plant will proceed with construction of final mill of 4000 tons daily capacity.

Mohave County

CHAMPION (Cerbat)—Recently put a force at work mining rich zinc ore.

TOM REED (Oatman)—The clean-up for February yielded four bars of bullion valued at $100,000.

GOLD ROAD (Goldroad)—Recently shipped $17,000 worth of bullion. Mill has run for some time on low-grade material broken several years ago in stopes on west side of No. 1 shaft. As soon as these stopes are clear a careful investigation of that part of mine will be made.

Pinal County

RAY CONSOLIDATED (Kelvin)—Production for January was 4,090,025 lb., compared with 5,105,000 lb. in corresponding month last year and with 3,126,536 lb. in December.

Santa Cruz County

RUPERT (Patagonia)—Sold to Eastern people recently, who will soon resume operations.

WORLDS FAIR (Patagonia)—Shipments increased to 30 tons daily. Mine operated by Louis N. Nofer.

FLUX (Patagonia)—Two carloads of mine equipment have been shipped. Installation expected to be completed in May and mine to be ready to ship ore in June.

Yavapai County

MONARCH (Crown King)—New hoist being installed and sinking to be resumed.

MONICA—J. A. Park, of Philadelphia, is head of a syndicate to take over the Monica property. Old workings are being cleaned out and ten stamp mill rehabilitated.

BROOKLYN-ARIZONA (Mayer)—Boston capitalists who recently ecquired the Brooklyn-Arizona properties planning to resume operations. Property has been in litigation for last two years.

CALIFORNIA

Amador County

PLYMOUTH (Plymouth)—New mine hospital has been completed and thoroughly equipped. This will reduce the cost of caring for injured men formerly sent to hospital at Sacramento.

CENTRAL EUREKA (Sutter Creek)—Repair work on tailing flume nearing completion. Flume put out of commission temporarily by January storms and 20 of the 40 stamps were hung up. Shaft will be deepened 100 ft.

Calaveras County

CALAVERAS COPPER (Copperopolis)—Mine leased to Coffer and Trask and is being unwatered. Good orebody disclosed in Union shaft.

MELONES (Melones)—Twenty new stamps will be added to the 100-stamp mill. Four miles of the flume which furnishes mill water and power will be rebuilt during the summer.

ORO WATER, LIGHT & POWER CO. (Oroville)—The 6-cu.ft. bucket dredge on Mokelumne River, near Clements, under construction since November, is completed. Part of machinery from old Empire dredge was used. New machinery was built at the New York machine shops at Oroville. C. G. Leeson superintended construction. Benjamin Fowler is dredgemaster.

ROYAL GOLD (Hodson)—Shaft has been unwatered 550 ft. to 600-ft. level. Forty stamps of the 120 have been put in shape and will be put in operation on arrival of amalgamation plates. New tramway will be completed last of this month. Additional stamps will be put in operation as fast as practicable.

Eldorado County

UNION EXTENSION (Eldorado)—Preparations being made to reopen old Union mine, which in early days was large gold producer from depth of 1300 feet.

RED TOP (Eldorado)—Ore from this mine will be treated at Hillside mill. Development of Hillside mine will be resumed by W. G. Busick, superintendent of both properties.

Inyo County

SILVER-LEAD claims have been located in Marble Cañon by J. W. Messick. Ledge appears to be about 6 ft. wide well defined.

NEW COSO MINING CO. (Oakland)—Foreclosure sale in Superior Court of Inyo County to satisfy claims of about $20,000 held chiefly by Inyo County Bank and Walter B. Young.

Los Angeles County

PACIFIC MINERAL PRODUCTS CO. (Los Angeles)—Plant installed at Avenue Nineteen and Humboldt St., between the Sante Fe and the Salt Lake tracks, opened on Mar. 10. Said to have cost $200,000. Is to treat mineral substances of California and Arizona, making a specialty of soapstone, talc, fuller's earth, manganese and tungsten. V. Mott Pierce of Buffalo, N. Y., is president.

Mono County

STANDARD (Bodie)—Property sold to J. S. Cain Co. in settlement of suit against Standard Consolidated Mining Co., for ore extracted from Midnight. Reported that Standard and South End mines will be consolidated and South End ores will be worked through Standard mine and mill. Property has complete equipment, cyanide plant, pole line and water rights.

Nevada County

HIGHGRADE (Emigrant Gap)—Property reported to be bonded to Samuel Newhouse. Small force of men employed preparing for development work in the spring and hauling in of machinery and supplies. Property is in Meadow Lake district which in early days supported a town of 3000 people known as Summit City.

BRUNSWICK CONSOLIDATED (Grass Valley)—Contemplated construction work includes new headframe at the vertical shaft, new mill equipment, small cyanide plant for treating concentrates, assay office, and probable addition to pump equipment. Development below the 1250-ft. level continues satisfactory and Brunswick vein is yielding excellent ore.

EXCELSIOR (Emigrant Gap)—This property in Meadow Lake district on which was made first discovery of gold in district in 1863 to be reopened by Excelsior Consolidated Mining Co. composed of men of Worcester, Mass. Necessary equipment for development is being installed and installation of mill is contemplated. Property is situated in one of deepest snow regions in the West, can only be operated economically in winter with proper equipment and supplies hauled in from Emigrant Gap, distance of 38 miles by wagon road and trail.

Trinity County

GOLDEN JUBILEE (Carrville)—Mine reopened is equipped with hoist and 10-stamp mill. New equipment contemplated includes cyanide plant. Upper workings in good repair and enough ore was left blocked out by former operators to keep the mill going while development proceeds. C. L. Probestel is manager.

HEADLIGHT (Carrville)—Resumption of mining and milling is contemplated. Mine formerly good producer of ores amenable to cyanidation. Encountering heavy sulphides necessitated a change in metallurgical methods which will be made when mining is resumed. D. W. Shanks of Trinity Consolidated Hydraulic Mining Co. operating the Union Hill and Hupp mines at Weaverville, is manager.

San Bernardino County

ORO BELLE (Hart)—Optioned to Tonopah Belmont company of Tonopah. Property 14 miles west of Searchlight, Nev., in Hart mining district. Has shaft 814 ft. deep. Fifteen feet of ore in shaft said to average $8.44 gold per ton.

Sierra County

YORK (Downieville)—Caved shaft, from which bonanza ore was taken several years ago, will be reopened and a modern milling plant will be installed.

GOLD BLUFF (Oxford)—A 250-ft. tunnel being driven to cut Meserve ledge at depth on Oxford ground. Repairs to Gold Bluff mill have been completed and stamps will soon be in operation. Sol Camp has charge.

CLEVELAND (Sierra City)—Mine has been bonded to R. G. Gillespie who is making extensive repairs to mill and all buildings and has let contract for sinking. A tunnel at river level will be driven during coming summer.

PLUMBAGO (Alleghany)—The 20-stamp mill and concentrating plant destroyed by fire Mar. 17, loss about $35,000, of which $15,000 is covered by insurance. The fire supposed to have originated in the transformers. This mine is owned by Croesus Gold Mining Co. and is one of richest in the district. Walter B. Pearson is manager.

COLORADO

Boulder County

UNITED STATES GOLD CORPORATION (Boulder)—Additional machinery for mill has been ordered and management hopes to have plant completed in about thirty days.

Clear Creek County

GOLD SOVEREIGN MINING & TUNNEL CO. (Cripple Creek)—This property is being equipped with additional machinery preparatory to sinking the shaft which now has a depth of 1250 ft.

ENGINEERS LEASING CO. (Idaho Springs)—Station on the 100-ft. level below the Newhouse Tunnel has been completed. The flow of water encountered has been much less than expected, about 10 gal. per min. Drifting has commenced on an 18-in. vein that assays 6.3 oz. gold and 12 oz. silver per ton. The company is developing a block of ground 100 ft. high and 450 ft. long.

Lake County

COLORADO MINERALS SEPARATION CO. (Leadville)—Philadelphia interests have formed this company under Delaware laws to build mill to treat zinc ore in Leadville dumps. Reported that an electrostatic plant for zinc separation is planned.

San Juan County

BIG GIANT (Silverton)—Sufficient milling ore has been opened up to warrant the lessees to overhaul and remodel the Contention mill.

BONNER (Burro Bridge)—Pay ore has been opened and two carloads of $60 ore have been sorted out for shipment to smeltery. Lessees contemplate construction of small testing mill.

San Miguel County

CONCENTRATES SHIPPED FROM TELLURIDE during February totaled 97 cars. Shipments to the smeltery at Durango included 48 cars from the Tomboy, 26 cars from the Smuggler-Union, and 11 cars from the Liberty Bell. The Smuggler-Union also shipped 11 cars of zinc concentrate to the zinc smeltery at Blende.

PRIMOS CHEMICAL CO. (Vanadium)—Recent prospecting on a blanket vein owned by this company further up the mountain than the old workings has justified extensive development. Shaft will be sunk to depth of 400 ft. Compressor plant hoist and drilling equipment will be installed. Power line, 3500 ft. long, from lower to upper workings, is under construction by the Western Colorado Power Company.

IDAHO

Shoshone County

SUCCESS (Wallace)—Over 20 ft. of ore in winze sunk 100 ft. below 900-ft. level, most of which averages 30% zinc and the rest 8 to 10% lead. Mine shipping 80 tons concentrates daily that average about 40% zinc.

INTERSTATE-CALLAHAN (Wallace)—Constructing aërial tramway from mill to railroad, a little less than two miles, to eliminate wagon haul. Is shipping 150 tons per day of ore and concentrates averaging 50% zinc.

HIGHLAND-SURPRISE (Kellogg)—Flotation plant to be added to 100-ton mill, which will be ready to start June 1. Wagon haul nine miles to railroad. Previous ore shipments, both lead and zinc, amount to over $100,000.

FRISCO (Gem)—Flotation plant recently installed is to have several units added and the crushing capacity is to be increased by another tube mill. Body of zinc-lead ore cut in raise from 2200-ft. level. Report, unofficial, that mine will be in operation by Apr. 15.

MORNING (Mullan)—Employment of about 30 men placing new compressor and other preliminary work indicate preparation for resumption after long shutdown. High price of zinc and improved lead market, both important products of the mine, reason for resumption. Owned by Federal Mining & Smelting Co.

MICHIGAN

Copper

AHMEEK (Ahmeek)—Stamp mill will be ready in 60 days to handle 1400 additional tons, bringing tonnage up to 4000 daily.

OSCEOLA CONSOLIDATED (Osceola)—To increase rock tonnage to 5000 tons daily about July 1. Present tonnage is 4400 tons daily.

CENTENNIAL (Kearsarge)—Accident to compressor plant interfered with mining at this Calumet & Hecla subsidiary for a week, but rock tonnage was maintained. Plant again in operation.

COPPER RANGE (Painesdale)—Production of copper from two of the three mines of this corporation, Baltic and Champion, will be 15 per cent. above normal for the month of March if present production holds out.

Iron

PENN IRON MINING (Vulcan)—Crushing plant is being erected at Curry Shaft. Similar plant for Brier Hill shaft is under contemplation.

OLIVER IRON MINING CO. (Negaunee)—Blue mine of Queen group will be closed down on April 1. Ore supply is exhausted. Has been operated about 25 years; the fee is owned by the Breitung company.

JONES & LAUGHLIN (Ishpeming)—Company plans to resume shaft sinking at Iron Mountain Lake property Apr. 1. New boilers will be installed and new pumps at work. Work had to be stopped in December because shaft filled with water due to striking a large water course not known to exist. Shaft is down about 350 ft. and will have to be sunk to 600 ft. before drifting can be started. Some of samples from drill holes assayed 63% iron.

MINNESOTA

Mesabi Range

ARTHUR MINING CO. (Calumet)—Stripping operations were resumed this week on property between Calumet and Marble. It will be late in fall, or spring of 1916, before enough overburden will have been removed to allow ore to be mined.

DEAN (Buhl)—Todd-Stambaugh & Co. have contracted to take 300,000 tons of ore from this mine this season. This is first sale of ore reported from Mesabi range this year. The ore will be shipped to Cleveland. The price will be agreed upon later when the going prices of iron ore are fixed.

ORDEAN (Virginia)—Engineers are busy running lines on this property, which will be stripped by the Oliver Iron Mining Co. Stripping will be started within a few weeks. The property consists of only 40 acres but has rich ore. It is not expected that ore shipments will be made until 1916.

KANSAS

Cherokee County

THE HARTFORD MINES are running full force again for first time since strike of men for higher wages on account of increased price of spelter. Mines were shut down temporarily but new men were secured and operations have been resumed with full force.

OPERATION ON THE JAMES MURPHY LAND has been suspended on account of breaking of flume and consequent flooding of mines in lowlands during recent heavy rains. Preparations being made to unwater the ground again. This is the first time for three years that this ground has been overflowed.

MONTANA

Fergus County

BARNES KING DEVELOPMENT CO. (Kendall) — Bullion shipped from North Mocassin mine for February was $41,705 secured from 4287 tons of ore, giving a yield of $9.73 per ton.

NEVADA

Churchill County

GOLD STRIKE (Alpine)—In Stone Cañon north of Alpine 10 in. of ore opened in 150-ft. shaft assaying $150; being sacked for shipment to Fallon.

Elko County

ARTHUR ZINC MINING CO. (Ruby)—Ore shipments will commence at once; wagon haul to railroad is 40 miles.

BUNKER HILL MINING CO. (Elko)—Suit for damages to amount of $5000 filed by former lessee. Plaintiff claims lease revoked without cause soon after work started.

Esmeralda County

FLORENCE (Goldfield)—Sinking of main shaft will be postponed 60 days.

JUMBO EX. (Goldfield)—Is now operating again on normal scale as result of working agreement with litigant.

NEW GOLDFIELD SIMMERONE (Goldfield)—Organized to resume work on the old Simmerone. H. C. Cutler will be manager.

FLORENCE AMERICAN (Goldfield)—Work will be resumed, 800-ft. shaft will be sunk to 1000-ft. level and lateral development work on 500-, 600- and 800-ft. levels will be continued.

KEWANAS (Goldfield)—Station, sump and orepocket cut on 840-ft. level; lateral development will now be done. This level reached by winze from 700-ft. level of Laguna shaft. Electric hoist installed on 700-ft. level.

ATLANTA (Goldfield)—Incline raise from 1750-ft. level opened oreshoot 6 or 7 ft. wide assaying $20 per ton. Vertical raise being lifted from 1750-ft. level to connect with winze from 1400-ft. level of Grizzly Bear workings of Goldfield Consolidated for ventilation. Lease acquired on south half of Grizzly Bear claim below 1400-ft. level.

Humboldt County

SMALL STAMP MILL FOR HAYSTACK is being built. Mill will have capacity of 15 tons daily; steam power to be used. Considerable tonnage free-milling ore, assaying $12 to $18 per ton, on dumps.

DELAWARE (Seven Troughs)—Reported to be contemplating erection of mill. Vein averages 5 to 7 ft. of $18 ore.

LEONARD CREEK PLACER STRIKE made recently is developing satisfactorily. Gasoline pump, hoist and long line of sluices will be installed.

COLE LEASE (Rochester)—This lease, together with Kallaher lease, building road to head of Codd and Big Four tramway, so that ore can be sent to new milling plant.

NEVADA VALLEYS POWER CO. is extending its line to Upper Rochester. Four-J, Big Four and Codd leases, on Nenzel Hill, and Lincoln Hill Co., at mine and mill, will use this power.

BIG FOUR (Rochester)—Oreshoot struck on lowest or 500-ft. level; drifting now under way. Raise 500- to 250-ft. level completed, making possible handling of all ore by tramway from lower tunnel.

Lander County

KATTENHORN (Maysville)—Operations at this silver mine suspended until rise in price of silver. Stated 1000 tons good-grade silver ore ready for shipment.

ELECTRIC POWER PLANT FOR BATTLE MOUNTAIN may be built. H. R. Lemaire and H. C. Christenson applied to county commissioners for franchise. Oil engines will be used.

Lyon County

OCHEECHEE (Yerington)—Operations begun by new owners. Shaft will be sunk 200 ft. deeper.

NEVADA PROGRESSIVE CO. (Yerington)—Oreshoot 4 ft. wide cut by crosscut on 200-ft. level.

Mineral County

BLACK EAGLE (Rawhide)—Mill closed; considerable repair work being done; expect operations will be resumed in near future.

AURORA CONSOLIDATED (Aurora)—Enlarged mill expected to resume operations Apr. 1. Zinc precipitate will be shipped to Goldfield Consolidated plant for refining.

PITTSBURGH-DOLORES (Rockland)—Milling plant completed, expected operations will begin immediately. Mine being retimbered; development work progressing satisfactorily.

GOLDFIELD-CANDELARIA COÖPERATIVE MINING CO. (Candelaria)—Company, new $200,000 incorporation, owns six claims in Goldfield district and has long-time lease on Bi-Metallic property at Candelaria. Operations, for present, will be confined to Bi-Metallic group. Development work done includes two shafts, 280 and 600 ft. deep respectively, and 10,000 tons $6 ore blocked out. Will sink 280-ft. shaft to 500-ft. level.

Nye County

TONOPAH PRODUCTION for week ended Mar. 13 was 10,586 tons, estimated gross milling value $216,508, compared with 10,408 tons last week, valued at $213,304. Producers were: Tonopah Belmont, 3889; Tonopah Mining, 2500; Tonopah Extension, 1820; West End, 1076; Jim Butler, 1100; Tonopah Merger, 150; and Montana-Tonopah 51 tons.

HALIFAX (Tonopah)—Shaft retimbered and mining operations will be resumed at once.

TONOPAH MINING CO. (Tonopah)—Net profit for January, $56,875; ore mined, 12,000 tons.

MIDWAY (Tonopah)—Operations resumed; two shifts employed. Shaft sinking from 1200-ft. level under way.

Storey County

COMSTOCK PUMPING ASSOCIATION (Virginia City)—Pump installation on 2700-ft. level of Mexican-Ophir winze and power cable on 2500-ft. level under way. Work of installing winches at 2500-ft. level winze station progressing satisfactorily.

CONSOLIDATION OF SOUTH END MINES at Virginia City will be made; application made to state corporation board of California. Mines concerned are, Yellow Jacket, Crown Point, and Belcher Gold & Silver Mining Co. New company will be called The Jacket, Crown Point, Belcher Mines Co. Old companies will receive shares in new, and, if permitted, 100,000 shares new stock at $1 will be issued.

White Pine County

STUART MILL (Cherry Creek)—Plant purchased recently and will be operated as custom mill.

New Mexico—Grant County

CHINO (Hurley)—Production for January was 3,563,681 lb., compared with 2,827,891 lb. in December and with 6,401,911 lb. in January a year ago.

OREGON

Baker County

BEN HARRISON (Sumpter)—The purchase of this mine by the A. S. & R. Co. and its intention to install concentrating plant is officially denied by the latter company.

Lincoln County

ABERT AND SUMMER LAKE PROJECT (Newport)—Preliminary investigation plans being made by J. G. Kelley, engineer, Portland, for pipe line of Oregon fir 14-in. diameter, 270 miles long, costing two million, to connect Abert and Summer Lakes with Columbia River at intersection of Des Chutes where plant will be built. Reported Gould interests backing project. Finances arranged for immediate construction. J. C. Moore, of 141 Broadway, New York, is president.

PENNSYLVANIA

GRASSELLI CHEMICAL (Newcastle)—Will double present capacity of local plant to cost $200,000 for manufacture of sulphuric acid.

UTAH

Salt Lake County

UTAH COPPER CO. (Salt Lake)—Production in January 8,009,646 lb., compared with 6,795,560 lb. in December, and 10,649,036 lb. in January a year ago. Not for five months has output been as high as 8,000,000 pounds.

BINGHAM MINES (Bingham)—In 1914 the Dalton & Lark mine produced 30,292 tons of lead-silver and copper ore, value $224,336; Commercial, 20,433 tons copper ore, value $67,450; Yosemite, 693 tons lead ore, value $11,770; Eagle & Blue Bell, 32,736 tons, value $513,235. Net receipts from ore shipments from Eagle & Blue Bell, $286,485, net operating profit for year, $121,536. Company's net gain and income for year, $172,530.

Summit County

PARK CITY ORE SHIPMENTS for week ended Mar. 12 were 4,477,460 pounds.

PARK CITY MILLS (Park City)—Company will install Holt-Dern roaster of 35 to 50 tons daily capacity. Extraction of 85% expected. Company operated on American Flag ores in 1914, but roasting difficulties encountered made changes necessary. Chloridizing is used.

SILVER KING CONSOLIDATED (Park City)—Report for year ended Feb. 1 showed 9987 dry tons ore shipped, value $346,990, after payment of smelting charges and freight. Ore averaged 50.44 oz. silver, 0.0514 oz. gold, 28% lead, 1.291% copper, bringing $34.74 per ton net at smeltery.

WASHINGTON

REPUBLIC CONSOLIDATED (Republic)—Electric hoist is to be added to equipment this summer, together with a 700-ft. compressor having a capacity for 17 drills.

CANADA

British Columbia

HEDLEY GOLD (Hedley)—In 1914 treated 78,494 tons ore average $10.80, all of which came from Nickel Plate property. Ore reserves equal to those of year ago.

BERRY DREDGE (Circle)—Freighting Berry dredge from Circle City to Mammoth Creek completed and work of assembling will commence at once. Contract for 1500 cords of wood to dredge practically completed.

TAMARAC (Highland Valley)—Johns & Keffer, formerly on the staff of the B. C. Copper Co., have bonded this group which lies about 25 miles south of Ashcroft. The bond provides for continuous development after first of July.

GRANBY CONSOLIDATED (Grand Forks)—Completion of fourth furnace at Anyox expected within 60 days. Company will then have total capacity of 50,000,000 lb. copper per year. Production costs at Anyox reported to be 20% lower than at Grand Forks plant. January output of two smelteries 2,170,139 pounds.

MERRY WIDOW (Vancouver Island)—Stewart Mining & Development Co. has bonded this group and has 90 men at work. Diamond drilling has disclosed orebodies averaging 3½% copper, 70c. in gold and 50c. in silver per ton. Contract has been let for constructing an electric railway from property to South East Arm of Quatsino Sound, distant 12 miles. Hydro-electric plant will be installed to furnish power to mine.

Ontario

COBALT ORE SHIPMENTS for week ended Mar. 12 were: 724,503 lb., as follows: Mining Corporation, 173,820 lb.; Nipissing, 129,675; Dom. Reduction, 88,000; O'Brien, 40,920; McKinley-Darragh, 84,630; La Rose, 84,740; Beaver Con., 122,718 lb. Week's bullion shipment: Crown Reserve, 19,500 oz. valued at $10,000.

NORTH THOMPSON (Porcupine)—Has been closed down. Lack of funds is supposed to be the reason. Property controlled by Associated Gold Mines of Western Australia.

DOME (Porcupine)—Is operating mill from power from its own power house. Shortage of water in Mattagami River, which caused a partial shut down of the hydro electric plants, is the reason.

NIPISSING (Cobalt)—A short time ago an attempt was made by two German-Poles to blow up company powder magazine. Explosion averted by defective fuse which burned to within 4 in. of primer and went out.

TIMISKAMING (Cobalt)—Stated at annual meeting, Mar. 16, that the big vein followed from Beaver workings on 500-ft. level has been encountered in drift on 460-ft. level, where it is 7 in. wide, average assay 3500 oz. silver.

HOLLINGER (Porcupine)—The new central main shaft has passed the 400 ft. level and will be put down to 2000 ft. To meet power shortage one of the 35 drill compressors, installed last fall has been converted into a steam engine of 1500 hp.

McKINLEY-DARRAGH (Cobalt)—Annual report shows total of 1,396,540 oz. silver recovered, smallest production since 1909. Cost of production increased from 22⅛c. in 1913, to 31¼c. in 1914. Total estimated reserve was 2,132,000 oz. as against 3,210,000 oz. previous year. Total net profits were $307,652, and dividends amounted to $404,584.

ALGOMA STEEL (Magpie Mine)—Extensive improvements being made on roasting plant at Magpie. Original hot-ore conveyors proved unsatisfactory and are being replaced by rotary coolers 4½ ft. diam. brick lined throughout. Gases entering kilns will pass through coolers, over hot ore; expected to save large amount of heat. Capacity of drying plant in powdered coal mill being doubled to insure coal below 0.75% moisture at all times.

MEXICO

Sonora

SAN MIGUEL (San Miguel)—This mine in Soyopa district resuming activity, has just imported auto truck and a passenger roadster for use between mine and Hermosillo. Consul states 500 Mexicans killed by Yaquis during past year along this trail.

NICARAGUA

PANAMA MINING CO., now controlled by Tonopah Mining Co., of Nevada, is constructing large power plant and will build 100-ton fine grinding and cyanide mill. Rolls will be used for crushing instead of stamps.

The Market Report

METAL MARKETS

NEW YORK—Mar. 24

Copper and lead have been distinctly stronger, especially on account of foreign demand. The business in tin was but trifling, and quotations for this metal are essentially nominal. The situation in spelter is confused. Fancy prices are being realized on the small demand for near-by shipments, while smelters are unable to sell their usual contracts in any free way.

Copper, Tin, Lead and Zinc

Copper—At the close of our last week of record, the market was about 14¾@14⅞c., regular terms, with one large agency selling at or near the lower figure. It having apparently disposed of all that it wanted to at that price, the market began to advance on Mar. 18, although the domestic demand was not very large. However, certain sellers who had special facilities in the European markets and in some noncompetitive markets were contented with them, and abstaining from this market left it in a position to respond quickly to any increase in demand. A moderate volume of business was transacted, but nowhere near so much as was paraded in the daily papers. The dearth of freight room has put the European market entirely out of joint with the American, and all kinds of fancy prices are realized by sellers who are so fortunate as to have stocks available for prompt delivery abroad, or contracts for freight room wherein to make early shipments. The demand for copper during the last week, both foreign and domestic, is attributed to military requirements, rather than peaceful. The form in which copper is sold is not always an index of what it is to be used for. Thus, it was found that cakes, which ordinarily are used for sheet rolling, are being bought to make bands to go around shells.

At the close of our week of record, sales as high as 15⅜c., regular terms, corresponding to about 15.20c., cash, New York, had been made, and bids of 15c., cash, New York, had been rejected.

Copper sheets were advanced ½c. on Mar. 22, the base price being now 20¼c. per lb. for hot rolled and 21¼c. for cold rolled. Usual extras charged and higher prices for small quantities. Copper wire is quoted at 16¼@16½c. per lb., carload lots at mill.

Visible Stocks of Copper in Europe on Mar. 17 are reported as follows: Great Britain, 15,870; France, 1985; afloat from Chile, 1025; afloat from Australia, 4400; total, 23,380 long tons, a decrease of 436 tons from the Feb. 28 report.

Tin—Quotations on this metal represent actual transactions, but business is so small as to make them nothing but nominal. Orders to buy and sell a few tons swing the market one way or another. The conditions remain substantially as chronicled in our recent reports. Thus, on Mar. 24, somebody tried to sell a few tons, and this resulted in putting the price down to 48 cents.

Lead—There was some large business done for export, but nowhere near so much as reported in the previous week. The absorption of lead was sufficient, however, to induce the A. S. & R. Co. to advance its price to 4.15c., New York, on Mar. 24. The St. Louis market continued to rule above the normal differential owing to the buying of lead there for export and its shipment through Galveston. The condition continued to prevail also that domestic consumers could buy lead at five points or so below what was being realized on the foreign business.

The Chihuahua plant is the only one of the works of the A. S. & R. Co. in Mexico at work at the present time.

We find that we were in error in estimating the export sales of lead in the week Mar. 10-17 at 15,000 to 20,000 tons, as stated in our last report, having duplicated certain sales. An estimate more nearly correct would be 10,000 to 15,000 tons.

Canada was a large buyer of lead on Mar. 18 and 19.

An estimate of domestic consumption of lead at the present time is about 65% of normal.

Spelter—The willingness of buyers to pay fancy prices for metal required immediately, and their unwillingness to buy anything else, became again emphatically in evidence in the early part of the week, when sales of several hundred tons of spot, prompt and near-by spelter were made at around 9c., while there were sellers of May spelter at 8c. and April-May at 8@9c. After all danger of labor difficulties among the smelters was removed, spot and near-by spelter was offered down to 8½c. It is impossible to quote the spelter market with any precision. Buyers in immediate need of supplies are willing to pay high prices for them, but such business, although it may amount to some hundreds of tons per week, is far short of what smelters are obliged to sell, and buyers are unwilling to enter into the usual contracts. This situation, which is just as impossible as that which existed about two or three weeks ago, explains why ore prices in Joplin, a free market, have declined to $60 per ton and under.

DAILY PRICES OF METALS IN NEW YORK

Mar.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc	
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.
18	4.7950	50⅛	14.65 @14.75	*53	4.10 @4.15	4.05 @4.10	*8.17½ @9.17½	*8.00 @9.00
19	4.7925	50⅜	14.65 @14.75	*52	4.10 @4.15	4.05 @4.10	*8.17½ @9.17½	*8.00 @9.00
20	4.7938	50¼	14.75 @14.85	*52	4.10 @4.15	4.05 @4.10	*8.17½ @9.17½	*8.00 @9.00
22	4.7913	50⅜	14.80 @15.00	*53	4.10 @4.15	4.07½ @4.12½	*8.17½ @9.17½	*8.00 @9.00
23	4.7913	50⅜	15 00 @15.20	*52	4.10 @4.15	4.07½ @4.12½	*8.17½ @8.67½	*8.00 @8.50
24	4.7900	50⅜	15.10 @15.20	*53	4.15 @4.20	4.10 @4.15	*8.17½ @8.67½	*8.00 @8.50

* Nominal.

The quotations herein are our appraisal of the markets for copper, lead, spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The difference between the price delivered and the New York cash equivalent is at present 0.15 to 0.20c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Western brands. Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are; St. Louis-New York, 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Feb.-Mar.	Silver	Copper				Tin		Lead		Zinc	
		Spot									
		£ per Ton	Cts. per Lb.	3 Mos.	Best Sel'td	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
18	23⅞	67	14.56	67½	....	187	173½	23½	5.02	44½	9.61
19	23 11/16	67	14.56	67½	....	178	167	22⅞	4.92	44¼	9.61
20	23¾	.....	.....	.....	.....	.....	....	.....	.....	.....	....
22	23 11/16	68¼	14.83	68¾	....	171	166½	22⅞	4.97	44¼	9.61
23	23 11/16	69	14.99	69½	....	173	167	23½	5.02	43¾	9.51
24	23 11/16	68½	14.88	69½	....	168½	165	23½	5.02	44	9.56

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £15 = 3.21c.; £20 = 4.28c.; £30 = 6.42c.; £40 = 8.55c.; £60 = 12.83c. Variations, £1 = 0.21⅜ c.

Zinc sheets are quoted today at $13.50 per 100 lb. f.o.b. La Salle, Ill., less 8% discount. Usual extras charged. The manufacturers have received a number of inquiries from abroad.

The Pittsburgh Zinc Co. has made arrangements to start up its plant at Pittsburg, Kan., which was idle throughout 1914. A contract for a supply of Western ore is said to have been made.

The labor troubles among the zinc smelters of Kansas and Oklahoma were general. At Caney, Dearing and Cherryvale, things were settled right away by an increase of 25c. per day to the furnace men. The companies operating in Collinsville and Bartlesville had until Mar. 20 in which to settle things. Before that time a compromise was effected by the same advance as at the other places, and with the week beginning Mar. 22 everything was in full blast again.

The United States Zinc Co., a subsidiary of the American Smelting & Refining Co., which operates the zinc smeltery at Pueblo, Colo., has purchased the plant of the Tulsa Spelter Co. at Sand Springs, Okla., which was built last year by C. A. H. de Saulles and George E. Nicholson. This plant will probably be run on ores from the mines of the A. S. & R. Co.

The recent sale of 2000 shares of the Edgar Zinc Co., 20% of its capital stock, is supposed to be a matter of some importance in the affairs of that company.

Foreign Trade of the United States in metals other than iron and steel, year ended Dec. 31:

	Exports		Imports	
	1913	1914	1913	1914
Copper, long tons	425,302	382,588	182,491	136,764
Tin, long tons	2,203	802	46,555	42,433
Lead, short tons	80,267	44,544	57,147	28,338
Zinc, short tons	8,403	70,242	6,100	880
Nickel, lb.	29,173,088	27,595,152	47,194,101	35,006,770
Antimony, lb.	63,920	1,600,979	15,383,355	17,490,315
Aluminum, lb.	44,535	129,750	23,185,775	16,241,340
Quicksilver, lb.	85,521	108,426	.....	.....
Platinum, oz.	1,191	143	117,974	72,267

Copper, lead, nickel and antimony totals include metallic contents of ores, matte, etc. Exports include reëxports of foreign material. In addition to the exports in the table manufactures of aluminum were exported valued at $966,094 in 1913, and $1,546,010 in 1914; the quantities not given.

Exports of Metals and Minerals in Spain, year ended Dec. 31, reported by "Revista Minera," in metric tons:

	Metals		Ores, etc.	
	1913	1914	1913	1914
Iron	7,626	39,176	8,097,309	6,083,193
Copper	24,091	16,320	160,509	81,900
Copper precipitate	5,870	10,056	.....	.....
Lead	203,440	148,997	2,349	1,727
Zinc	1,044	3,478	114,419	66,949
Quicksilver	1,489	7,285	.....	.....
Manganese	.....	.....	27,793	8,985
Pyrites	.....	.....	2,903,554	2,664,948
Salt	.....	.....	564,041	509,936

Imports of coal in 1914 were 2,504,085 tons; of coke, 370,768 tons. Imports of superphosphates and basic slag were 113,673 tons; of nitrate of soda, 36,376 tons.

CONTRABAND

Additions to the British contraband list, proclaimed Mar. 13, include the following mineral products: Tin, chloride of tin and tin ore; paraffin wax; copper iodide; lubricants; ammonia and its salts, simple or compound; liquid ammonia.

Other Metals

NEW YORK—Mar. 24

Aluminum remains quiet and rather dull. Prices are slightly easier, 18¾@19c. per lb. being quoted for No. 1 ingots, New York—**Antimony** is scarce and there is very little spot offering. Chinese and Japanese are the principal supplies. Ordinary brands bring 21½@23½c. per lb. The better brands are largely nominal, Cookson's being held at 29@30c., with very little to be had—**Nickel** is unchanged, ordinary forms being 40@45c. per lb., according to size and terms of order. Electrolytic, 3c. higher—**Quicksilver** is still in rather short supply. For large lots in New York the price is nominally $65. Small lots have sold up to $70@75 per flask. San Francisco price is reported by telegraph at $60@62.50 per flask for domestic orders; no sales for export. London price is £12 5s. per flask.

Minor Metals—Current sales of **Bismuth** have been at $2.75@3 per lb., New York. **Selenium**—Quotations are $2@3 per lb. for larger quantities; $4.50@5 per lb. for smaller lots.—**Cadmium** is quoted in London at 6s.—$1.44—per lb.—**Tellurium** is reported sold at 80s.—$19.20—per lb. in London.—**Vanadium** to the quantity of 4820 lb. was included in the exports from Baltimore last week.

Gold, Silver and Platinum

NEW YORK—Mar. 24

Gold—An additional sum of $10,800,000 gold from Ottawa was received at New York this week. The total receipts at New York since Jan. 1 have been $38,400,000, of which $26,800,000 came from Ottawa on London account; $5,200,000 from China; $4,000,000 from Japan; the balance chiefly from South and Central America. The only exports were $2,000,000 taken for French account.

Gold production of the Kolar field in Mysore, India in February was $1,027,402. For the two months ended Feb. 28 the total was $2,081,283; an increase of $132,288 over last year.

Silver—The market has ruled quiet and steady this week with a good undertone. Indian Bazaar orders have continued, and there has also been buying for Continental demand. The market closes steady at 23 7/16d. in London.

Shipments of silver from London to the East, Jan. 1 to Mar. 11, as reported by Messrs. Pixley & Abell:

	1914	1915	Changes	
India	£1,400,000	£1,386,500	I.	£13,500
China	40,000	.....	D.	40,000
Total	£1,440,000	£1,386,500	I.	£53,500

Platinum—The market continues dull and no important changes can be noted. If anything there is slightly less firmness, and a smaller range of prices. There has been no advance, but some sales at low figures. We quote $38@40 per oz. for refined platinum, and $44@49 for hard metal, according to quality.

Iridium is still rather scarce and remains high. Prices are subject to negotiation and no general quotation can be given.

Zinc and Lead Ore Markets

PLATTEVILLE, WIS.—Mar. 20

The base price for 60% zinc ore declined this week to $63 per ton. The base price offered for 80% lead ore was $49@50 per ton. No sales of lead ore were reported.

SHIPMENTS, WEEK ENDED MAR. 20

	Zinc Ore, lb.	Lead Ore, lb.	Sulphur Ore, lb.
Week	3,930,500	.....	243,000
Year	44,274,260	618,390	3,971,600

Shipped during week to separating plants, 3,833,240 lb. zinc ore.

JOPLIN, MO.—Mar. 20

Blende, high price, $68; assay base 60% zinc, low in lead, $65@63; as lead content increased the base declined to $50; metal base not reported; calamine base, 40% zinc, $38@30; average selling price, all grades of zinc, $60.77, a decline of $7.48 per ton.

Lead, high price, $51; base $50 per ton of 80% metal content; average, all grades of lead, $49.60 per ton.

Heavy decline and light buying in zinc ores; an advance of $1 in lead.

SHIPMENTS, WEEK ENDED MAR. 20

	Blende	Calamine	Lead	Values
Totals this week	8,653,900	988,880	1,503,230	$333,170
Totals this year..	116,732,430	10,962,640	17,815,140	4,180,030

Blende value, the week,, $277,350; 12 weeks, $3,560,360.
Calamine value, the week, $18,540; 12 weeks, $200,240.
Lead value, the week, $37,280; 12 weeks, $419,430.

NEW CALEDONIA ORES

Exports of ores from New Caledonia for the year ended Dec. 31, 1914, were 55,474 tons nickel ore, a decrease of 37,718 tons from 1913; 48,852 tons chrome ore, a decrease of 14,918 tons. Exports of metals were 3005 tons nickel matte, a decrease of 2888 tons.

Iron Trade Review

NEW YORK—Mar. 24

The general tone of the iron and steel markets is still sound and hopeful. Business grows slowly, but so far there is no recession and gradual improvement is expected.

There has been some improvement in demand for structural steel as the open season approaches. Bridge and building work is increasing and more contracts are promised. The demand for plates and shapes for shipbuilding is good, while

agricultural implement makers are taking fair quantities of bars and other steel.

Export business is developing and some large orders are reported. Over 300,000 tons of heavy bars and other material, including 90,000 tons of wire, have been placed. The French government has contracted for 40,000 tons of rails. Other rail orders are noted, including quite a number for girder and other trolley rails.

The pig-iron market is still backward. The production is increasing, but the chief gain is in the steel works furnaces. Prices are not advancing.

Exports and Imports of Iron and Steel, and of manufactures thereof, in the month of January are valued as below by the Department of Commerce:

	1914	1915	Changes
Exports	$16,706,398	$18,053,421	I. $1,347,023
Imports	2,334,895	1,616,593	D. 718,302
Excess, exports	$14,371,503	$16,436,828	I. $2,065,325

The largest proportional increase in exports this year was in wire and wire products, though there were also large gains in sheets and in billets.

PITTSBURGH—Mar. 23

The steel trade is easily holding the ground gained in the movement of the past four months. Operations continue at the rate of fully 65% of steel ingot capacity, and shipping orders are being received at a rate sufficient to maintain the pace. In most cases the shipping orders received thus far in March exceed the bookings of the corresponding period of February. The notable feature is that demand for commodities of ordinary consumption, like wire, merchant bars, tinplate, sheets, etc., is practically normal, while demand for structural material, as well as railroad material generally, is light. While money is easy for ordinary commercial accommodations, very little indeed is flowing into new investments. In some quarters the belief is entertained that within the near future prospects for an early termination of the war will have so improved as to cause a marked loosening of funds for permanent investment and this would eventually bring a demand for steel along new lines, though the mills could hardly feel the direct effect, in increased operations for several months.

Galvanized sheets, contrasted with black sheets, are in very light demand on account of high prices forced by the scarcity of spelter. Steel prices are well maintained all along the line. In accordance with the program of mills announced early in February, bars, plates and shapes for March specifications are 1.15c. and for second quarter 1.20c., it being expected that the 1.15c. price will disappear at the end of this month.

Pig Iron—A sale of 500 tons of bessemer iron, at $13.60, Valley, for shipment during the balance of the month, is the first transaction in this grade of iron outside of carloads reported for many weeks. Basic iron is very quiet and buyers have not all been taking out their tonnages according to contract. Foundry iron continues quiet, with a similar condition prevailing so that the expected contracting for second quarter is not yet in evidence. Prices are unchanged: Bessemer, $13.60; basic, $12.50; No. 2 foundry, $12.75@13.25; forge, $12.50@12.75; malleable, $12.75, f.o.b. Valley; furnaces, 95c. higher delivered Pittsburgh.

Ferromanganese—Mills are expecting limited consignments to come from England in the near future. There is less fear entertained of an actual shortage, but it is recognized that relatively high prices will have to be paid for some time. The contract price remains at $78, Baltimore, as recently advanced, and subject to possibility of delivery. There is no definite spot market, but odd lots are quoted at not far from $100.

Steel—Shipments on contracts for billets and sheet bars have been heavier this month than last, but there is no new buying of the least consequence. The market is quotable unchanged at $18.25@18.50 for billets and $18.75 for sheet bars, f.o.b. maker's mill, Youngstown, and at $1 higher delivered Pittsburgh. Rods are $25, Pittsburgh.

IRON ORE

The movement of iron ore from the Lake docks is increasing, and promises to reach a fair total in March. There has been no discussion of season prices yet.

Imports and exports of iron ore in the United States in January, in long tons:

	1914	1915	Changes
Imports	101,804	75,286	D. 26,518
Exports	6,422	1,562	D. 4,860

Of the imports this year 54,850 tons were from Cuba, 7067 tons from Sweden and 5193 tons from Spain. The exports were to Canada.

The total Lake Superior ore on Lake Erie docks March 1 was 7,509,587 tons, which is 33,703 tons less than on March 1, 1913. The larger stocks were at Ashtabula and Cleveland.

FOREIGN IRON NOTES

Pig Iron Production in Germany in January is reported by the German Iron & Steel Union at 874,135 metric tons, which compares with 1,566,505 tons in January, 1914, a decrease of 692,370 tons. It was, however, 19,949 tons more than in December, 85,179 tons more than in November; and 287,484 tons more than in August, which was the lowest point of last year.

COKE

PITTSBURGH—Mar. 23

Connellsville—The Girard Iron Co., Girard, Ohio, has contracted with J. H. Hillman & Sons Co. for 10,000 to 12,000 tons of furnace coke a month to the end of the year, at a price understood to be a trifle under $1.75 at ovens, and Girard furnace will be blown in about Apr. 1. A large local interest is out with an inquiry for about 20,000 tons a month for the twelvemonth beginning July 1, but few sellers are disposed to quote for that delivery at this early time. Prompt furnace coke is selling in small lots at $1.50@1.60, according to grade. Foundry coke is $2@2.35 for prompt, according to grade, contract being nominal at about $2.15@2.30, at ovens.

Coal and Coke Tonnage of Pennsylvania R.R. lines East of Pittsburgh and Erie, two months ended Feb. 28, in short tons:

	1914	1915	Changes
Anthracite	1,585,731	1,665,857	I. 80,126
Bituminous	7,116,249	6,602,414	D. 513,835
Coke	1,660,502	1,427,303	D. 233,199
Total	10,362,482	9,695,574	D. 666,908

The total decrease in 1915 was 6.4%. The largest proportional loss was in coke tonnage.

Exports and Imports of Coal and Coke in the United States in January are reported by the Department of Commerce as below, in long tons:

	Exports		Imports	
	1914	1915	1914	1915
Anthracite	197,415	190,299	106	1
Bituminous	923,760	633,145	112,303	134,075
Coke	66,220	57,447	7,188	5,118
Bunker coal	607,652	528,418	.....	.....
Total	1,795,047	1,409,309	119,597	139,194

The greater part of the trade, both imports and exports, is with Canada. The bunker coal, or coal furnished to steamships in foreign trade, is practically all bituminous. There were decreases of 385,738 tons, or 21.5%, in exports; and of 19,594 tons, or 14.1% in imports.

Chemicals

NEW YORK—Mar. 24

The general market is rather unsteady and variable, with not much business forward.

Arsenic—Business continues quiet with sales moderate and good supplies. Quotations are unchanged at $3.75@4 per 100 lb. for both spot and futures.

Copper Sulphate—Business remains steady. Prices have been advanced 25c., present quotations being $5.75 per 100 lb. for carload lots and $6 per 100 lb. for smaller parcels.

Nitrate of Soda—Business seems to be improving and demand steadier. Quotations are unchanged, at 2.20c. per lb. for spot and up to July 1, and 2.17½ for later deliveries.

Imports and Exports of Raw Material for chemical manufacture, year ended Dec. 31, in long tons:

	Imports		Exports	
	1913	1914	1913	1914
Sulphur	14,636	22,810	89,246	98,462
Pyrites	848,674	977,372	.....	.....
Chrome ore	65,180	74,686	.....	.....
Magnesite	149,941	107,635	2,818	1,529

Exports include reëxports of foreign material. Excess of sulphur exports over imports in 1914 was 75,652 tons. Sulphur imported in pyrites in 1914 is estimated at 390,948 tons.

Imports and Exports of Chemicals in the United States, year ended Dec. 31, in pounds:

	Imports		Exports	
	1913	1914	1913	1914
Arsenic	6,688,216	4,079,372	66,000	700
Bleach	6,605,077	34,539,934	13,260	15,990
Potash salts	47,041,478	31,777,727	1,002,277	537,386
Acetate of lime	.....	.....	74,055,608	47,896,901

Exports include reëxports of foreign material. Imports of soda salts are not given in quantities; values were $324,922 in 1913, and $628,996 in 1914. Potash salts do not include those imported for use as fertilizers.

Assessments

Company	Delinqe	Sale	Amt.
Caledonia, Nev.	Mar. 8	Mar. 31	$0.05
Challenge, Nev.	Mar. 31	Apr. 21	0.05
Confidence, Nev.	Mar. 11	Mar. 31	0.10
Copper King, Ida.	Mar. 1	Apr. 1	0.005
East Hercules, Ida, (post.)	.....	Apr. 7	0.001
Eastern Star, Ida.	Mar. 25	Apr. 25	0.002
Emerald, Utah (three instal.)	.....	June 9	0.01
Enterprise, Ida.	Mar. 20	Apr. 20	0.002
Galena King, Utah.	Mar. 25	Apr. 25	0.0075
Great Falls, Utah.	Mar. 18	Apr. 22	0.01
Idaho-Nevada, Ida.	Mar. 10	Apr. 2	0.002
Index, Ida.	Feb. 27	Mar. 27	0.005
Indiana, Mich.	Feb. 4	.....	1.00
Iron King, Ida.	Feb. 18	Mar. 19	0.001
Jack Waite, Ida.	Mar. 1	Mar. 24	0.01
Kentuck, Nev.	Mar. 18	Apr. 7	0.02
Keystone, Utah. (post)	Feb. 23	Mar. 23	0.02
King Pine Crk., Ida.	Feb. 12	Mar. 13	0.002
Laclede, Ida.	Mar. 20	Apr. 6	0.003
Majestic-Idol, Nev.	Dec. 15	Jul. 20	0.005
Nabob, Ida.	Mar. 18	Apr. 12	0.005
Neva, Utah,	Mar. 18	Apr. 12	0.002
Nevada-Douglas, Nev.	Apr. 24	.....	0.10
Oreano, Ida.	Mar. 25	Apr. 26	0.0015
Overman, Nev.	Mar. 8	Mar. 26	0.05
Pioche Metals.	Mar. 20	Apr. 20	0.0025
Rescue-Eula, Nev.	Feb. 11	Mar. 22	0.01
Rio Grande, Utah.	Mar. 25	Apr. 17	0.003
Saltese, Ida.	Mar. 1	Apr. 1	0.002
Samson, Ida.	Apr. 3	May 3	0.002
Selma, Utah.	Mar. 20	Apr. 6	0.0025
Silver Cliff, Ida.	Apr. 3	Apr. 24	0.0025
Snowstorm Ex., Ida.	Feb. 19	Mar. 22	0.003
Sonora, Ida.	Mar. 15	Apr. 15	0.002
Sunset, M. & D., Nev.	Mar. 27	May 3	0.015
Syndicate, Ida. (post.)	.....	Jan. 28	0.001
Tarbox, Ida. (post.)	.....	Mar. 25	0.0025
Tar Baby, Utah.	Mar. 5	Apr. 5	0.005
Tonopah Midway, Nev.	Mar. 12	Apr. 12	0.01
Torino, Ida.	Feb. 20	Mar. 20	0.001
Utah, Nev.	Mar. 25	Apr. 15	0.02
Wanlass.	Jan. 30	Mar. 20	0.00375
Wolf Mountain, Utah.	Mar. 15	Apr. 14	0.0015

Stock Quotations

Among the securities sold at auction during the last week we note 2500 shares Cobalt Central at $17 for the lot.

COLO. SPRINGS Mar. 23		SALT LAKE Mar. 23	
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.04½	Beck Tunnel	.05½
Banner	.01½	Black Jack	.12
Cripple Cr'k Con.	.0065	Colorado Mining	.11
C. K. & N.	.06	Crown Point	.01
Doctor Jack Pot.	.08½	Daly-Judge	5.00
Elkton Con.	.45½	Gold Chain	.08
El Paso	1.45	Grand Central	.59
Findlay	.03½	Iron Blossom	1.00
Gold Dollar	.03½	Little Bell	.10
Gold Sovereign	.05½	Lower Mammoth	.05½
Isabella	.14½	Mason Valley	1.12½
Jack Pot	.06	May Day	.13
Jennie Sample	‡.02	Opohongo	.01½
Jerry Johnson	.03	Prince Con.	.37
Lexington	.0075	Seven Troughs	.02½
Mary McKinney	.33½	Silver King Coal'n.	2.90
Pharmacist	.01	Silver King Con.	1.72½
Portland	1.14½	Sioux Con.	.03½
Raven B. H.	.03½	Uncle Sam	.03
Vindicator	1.65	Yankee	.05

TORONTO Mar. 23			
Bailey	.03	Dome Exten.	.09
Coniagas	4.80	Foley O'Brien	.10
Peterson Lake	.23	Hollinger	23.00
Right of Way	.02	Imperial	.02
Seneca Superior	1.20	Jupiter	.11
Silver Queen	.01	McIntyre	.37
T. & Hudson Bay	23.00	Pearl Lake	.01½
Timiskaming	.24	Porcu. Gold.	‡.25
Wettlaufer-Lor.	.04	Preston E. D.	.01½
Big Dome	11.25	Rea	.12

SAN FRANCISCO Mar. 23			
Comstock Stocks		Misc. Nev. & Cal.	
Alta	.17½	Belmont	4.60
Belcher	‡.30	Jim Butler	.84
Best & Belcher	.06	Lone Star	.06½
Caledonia	.28	MacNamara	.03
Challenge Con.	‡.03	Midway	.16
Confidence	.15	Mont.-Tonopah	.45
Con. Virginia	.12	North Star	.14
Crown Point (Nev.)	‡.32	Rescue Eula	.11
Gould & Curry	.03	West End Con.	.58
Hale & Norcross	.04	Atlanta	.38
Julia	‡.01	Booth	.26
Mexican	.36	C.O.D. Con	.05
Occidental	.85	Comb. Frac	.08
Ophir	.08	Jumbo Extension	1.00
Overman	‡.10	Pitts.-Silver Peak	.12
Potosi	‡.02	Round Mountain	.40
Savage	.05	Sandstorm Kendall	.07
Sierra Nevada	.06	Silver Pick	.09
Union Con.	.16	Central Eureka	‡.25
Yellow Jacket	‡.47	So. Eureka	‡2.25

N. Y. EXCH. Mar. 23	
Name of Comp.	Clg.
Amalgamated	60½
Am.Sm.&Ref.,com	66½
Am. Sm. & Ref., pf.	103½
Am. Sm. Sec., pf. B.	‡78
Anaconda	28½
Batopilas Min.	½
Bethlehem Steel	69½
Bethlehem Steel, pf.	105
Chino	37½
Colo. Fuel & Iron	27½
Federal M. & S., pf.	23
Great Nor., ore., ctf.	33½
Guggen. Exp.	52
Homestake	116
Inspiration Con.	22½
Mex. Petroleum	71½
Miami Copper	24
Nat'l Lead, com.	58½
National Lead, pf.	107½
Nev Consol.	12½
Ontario Min	2
Phelps Dodge	‡175
Quicksilver, pf.	1
Ray Con.	18½
Republic I&S, com.	20½
Republic I&S, pf.	77½
SiossSheff'd, com.	26½
Tennessee Copper	30
Utah Copper	56
U. S. Steel, com.	47½
U. S. Steel, pf.	105½

N. Y. CURB Mar. 23	
Name of Comp.	Clg.
Beaver Con.	.30
Big Four	.07
Blue Bell	.03½
Braden Copper	7⅜
Buffalo Mines	.65
Can. Cop. Corpn.	1
Can. G. & S.	.04
Caribou	.47
Cashboy	.08
Chambers Ferland	.14
Con. Ariz. Sm.	.37½
Davis-Daly	.90
Diam'field-Daisy	.06½
Dia. Black B.	.03½
Ely Con.	‡.01
Florence	.58
Goldfield Con.	1⅛
Goldfield Merger	.22½
Greene Cananea	30
Kerr Lake	4 11/16
La Rose	.62½
McKinley-Dar-Sa.	.43
Mines of Am.	2
Mutual Min., pf.	‡2½
Nevada Hills	.25
New Utah Bingham	.56
Nipissing Mines	6⅛
Ohio Copper	.05
Oro	.11½
Pacific Smelt	.09⅜
South Utah	7
Stand'd Oil of N.J.	395
Standard S. L.	1⅛
Stewart	1⅛
Tonopah	7⅛
Tonopah Ex.	2⅜
Tonopah Merger	.38½
Tularosa	.12½
West End Ex.	.03
Yukon Gold	2⅛

LONDON Mar. 12			
Alaska Tre'dwell	£7	2s	6d
Camp Bird	0	6	1½
El Oro	0	8	3
Esperanza	0	9	3
Mexico Mines	4	0	7½
Oroville	0	11	6
Philippine Dr.	1	0	0
Santa Gert'dis.	0	8	9
Tomboy	1	3	0
Tough Oakes	0	13	7½

BOSTON EXCH Mar. 23	
Name of Comp.	Clg.
Adventure	1½
Ahmeek	300
Alaska Gold M.	34½
Algomah	1
Allouez	45½
Am. Zinc	27½
Ariz. Com., ctfs.	4½
Bonanza	.35
Butte-Ballaklava	2½
Butte & Superior	47½
Calumet & Ariz.	54½
Calumet & Hecla	405
Centennial	18½
Copper Range	39
Daly West	2½
East Butte	10½
Franklin	6½
Granby	70½
Hancock	12½
Hedley	26½
Helvetia	.30
Indiana	4½
Island Cr'k, com.	43
Island Cr'k, pfd.	86
Isle Royale	22½
Keweenaw	2½
Lake	10½
La Salle	4
Mass	7½
Mayflower	4½
Michigan	.85
Mohawk	61½
New Arcadian	6
New Idria Quick.	‡3½
North Butte	27
North Lake	1½
Ojibway	.85
Old Colony	4½
Old Dominion	43
Osceola	73
Quincy	60
Santa Fe	1⅛
Shannon	6½
Shattuck-Ariz.	23
Superior	28½
Superior & Bost.	1½
Tamarack	33½
Trinity	3½
Tuolumne	.25
U. S. Smelting	24
U. S. Smelt'g, pf.	42
Utah Apex	2 1/16
Utah Con.	11
Victoria	1½
Winona	2⅛
Wolverine	47
Wyandot	.60

BOSTON CURB Mar. 23	
Name of Comp.	Bid.
Alvarado	.70
Bingham Mines	3
Boston Ely	.15
Butte & Lon'n Dev.	.19
Calaveras	1 1/16
Calumet-Corbin	.13
Chief Con.	.85
Corbin	‡.50
Cortez	.15
Crown Reserve	.80
Eagle & Blue Bell	.78
First Nat. Cop.	1⅛
Houghton Copper	1⅛
Iron Cap Cop., pf.	3
Majestic	.13
Mexican Metals	.17
Nevada-Douglas	.34
New Baltic	1½
Oneco	.60
Raven Copper	‡.07
Smokey Dev.	.10
So. Lake	.06
Tonopah Victor	‡.17
Trethewey	.16
United Verde Ext.	3½

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	48.477	28.357	26.573	22.753
March	57.870	58.067	.....	26.669	26.788	.....
April	59.490	58.519	.....	27.416	26.958	.....
May	60.361	58.175	.....	27.825	26.704	.....
June	58.990	56.471	.....	27.199	25.948	.....
July	58.721	54.678	.....	27.074	25.219	.....
August	59.293	54.344	.....	27.335	25.979	.....
September	60.640	53.290	.....	27.986	24.260	.....
October	60.793	50.654	.....	28.083	23.199	.....
November	58.995	49.082	.....	27.263	22.703	.....
December	57.760	49.375	.....	26.720	22.900	.....
Year	59.791	54.811	.....	27.576	25.314	.....

New York quotations cents per ounce troy, fine silver: London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York		London			
	Electrolytic		Standard		Best Selected	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	14.394	65.259	63.494	70.188	*
March	14.131	.....	64.376	.....	69.170	.....
April	14.211	.....	64.747	.....	69.313	.....
May	13.991	.....	63.182	.....	67.786	.....
June	13.603	.....	61.336	.....	66.274	.....
July	13.223	.....	60.540	.....	64.955	.....
August	*	.....	‡	.....	‡	.....
September	*	.....	‡	.....	‡	.....
October	*	.....	‡	.....	‡	.....
November	11.739	.....	53.227	.....	*	.....
December	12.801	.....	56.841	.....	*	.....
Year	.....	.....	.....	.....	.....	.....

TIN

Month	New York		London	
	1914	1915	1914	1915
January	37.779	34.260	171.905	156.550
February	39.830	37.415	181.556	176.925
March	38.038	.....	173.619	.....
April	36.154	.....	163.963	.....
May	33.360	.....	150.702	.....
June	30.577	.....	138.321	.....
July	31.707	.....	142.517	.....
August	*	.....	‡	.....
September	32.675	.....	‡	.....
October	30.284	.....	‡	.....
November	33.304	.....	139.391	.....
December	33.601	.....	147.102	.....
Av. year	34.301	.....	.....	.....

LEAD

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	3.827	3.937	3.718	19.606	19.122
March	3.970	.....	3.850	.....	19.651	.....
April	3.810	.....	3.688	.....	18.225	.....
May	3.900	.....	3.808	.....	18.593	.....
June	3.900	.....	3.810	.....	19.417	.....
July	3.891	.....	3.738	.....	19.051	.....
August	3.875	.....	3.715	.....	‡	.....
September	3.828	.....	3.658	.....	‡	.....
October	3.528	.....	3.384	.....	‡	.....
November	3.683	.....	3.585	.....	18.500	.....
December	3.800	.....	3.662	.....	19.097	.....
Year	3.862	.....	3.737	.....	.....	.....

SPELTER

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.112	6.211	21.533	30.844
February	5.377	8.436	5.228	8.255	21.413	39.819
March	5.250	.....	5.100	.....	21.460	.....
April	5.113	.....	4.963	.....	21.569	.....
May	5.074	.....	4.924	.....	21.393	.....
June	5.000	.....	4.850	.....	21.345	.....
July	4.920	.....	4.770	.....	21.568	.....
August	5.568	.....	5.418	.....	‡	.....
September	5.380	.....	5.230	.....	‡	.....
October	4.909	.....	4.750	.....	‡	.....
November	5.112	.....	4.962	.....	25.016	.....
December	5.592	.....	5.430	.....	27.369	.....
Year	5.213	.....	5.061	.....	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported, ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1914	1915	1914	1915	1914	1915
January	$14.94	$14.59	$13.23	$13.45	$13.99	$13.90
February	15.06	14.55	14.12	13.45	14.08	13.90
March	15.07	.....	13.94	.....	14.10	.....
April	14.90	.....	13.90	.....	14.13	.....
May	14.90	.....	13.90	.....	14.27	.....
June	14.90	.....	13.90	.....	13.96	.....
July	14.90	.....	13.90	.....	13.90	.....
August	14.90	.....	13.90	.....	14.08	.....
September	14.90	.....	13.90	.....	14.03	.....
October	14.84	.....	13.75	.....	13.97	.....
November	14.59	.....	13.43	.....	13.83	.....
December	14.70	.....	13.45	.....	13.83	.....
Year	$14.88	.....	$13.78	.....	$14.01	.....